UNIT-I

FOOD SOURCES

FOOD:

- Food may be defined as substances, which when eaten and absorbed by the body, maintain life and growth. i.e., supply, build and repair tissues.
- Food is any edible substance, which gives energy for the work. It is usually composed of carbohydrates, fats, proteins and water, that can be eaten or drunk by an animal, including humans, for nutrition or pleasure.
- Food has been basic to our existence.
- It supplies energy producing materials to the body.
- It also provides substances for building and maintenance of the body.
- Thus food has many physiological functions to play.

SOURCES OF FOOD:

- The main sources of food are plants and animals.
- The foods we use daily include rice, wheat, dal, vegetables, fruits, milk, eggs, fish, meat, sugar, butter, oils etc.,
- Plants are autotropic and produce food in the form of carbohydrates utilizing sunlight, water, minerals and carbon dioxide by photosynthetic process.
- Animals and humans cannot synthesize food in their body and therefore depend on plants and other animals for food.
- Energy is provided in the human body by metabolic process involving the breakdown of carbohydrate, fat and protein constituents of food that is digested and absorbed.
- The energy value of food is measured in heat units called calories. A calorie is defined as the amount of heat required to raise the temperature of 1g of water through 1^0C.
- A kilo calorie is one thousand calories and is equal to 4.19 kilo joules. The energy yield of different foods is compared by determining the amount of energy given when the substance is completely oxidised by igniting it in an oxygen filled chamber under pressure and expressed as heat of combustion of food.
- However, the available energy from a food in the human body is slightly less than the corresponding heat of combustion value due to loss within the body.
- The energy yield of the main nutrients of food is given below,

NUTRIENT	HEAT OF COMBUSTION (K. Cal/100 g)	AVAILABLE ENERGY (K. Cal/100 g)
Carbohydrates	4.1	4
Fats	9.4	9
Proteins	5.7	4

TYPES OF FOOD:

Food is classified based on the physiological functions.

1. The food stuff that contains larger proportion of nutrients like carbohydrates and lipids are called energy-yielding food.
2. The food that contains greater proportions of proteins, minerals and water is called body-building food.
3. The food that has higher amounts of proteins, minerals, vitamins and some fat is called body-regulating food.

Food, nutrients and their functions:

S.NO	FOOD	NUTRIENTS	FUNCTIONS
1.	Cereals, roots, dried fruits, sugars, fats etc	Carbohydrates, Lipids	Energy-yielding
2.	Milk, meat, fish, egg, pulses, oil seeds, nuts, fish, liver oil etc	Proteins, Water, Minerals	Body-building
3.	Milk, egg, green leaves, fruits etc	Proteins, Minerals, Water, Vitamins	Body-regulating

Advantages and disadvantages of food:

The advantage and disadvantage of convenience food comparing nutrition is given below,

Advantages:

1. Modern production techniques and preservation methods minimize nutritional loss of precooked products.
2. Frozen vegetables take less time to prepare but often have the same nutritional value as fresh products they are frozen immediately after harvesting.
3. In most cases, the nutrients and vitamins are preserved.
4. Nutrition information is easily accessed by the nutrition label.
5. Efficient harvesting, transporting and storage techniques.

Disadvantages:

1. Convenience foods may be higher in fat making their energy content (calories) high.
2. These foods are often higher in sodium because it is a cheap flavour.
3. The cook cannot control the ingredients of the product; therefore it is harder to control the sugar, fat and salt content.
4. These foods allow little recipe modification.

CONSTITUENTS OF FOOD:

- Food may be defined as substances, which when eaten and absorbed by the body, maintain life and growth. i.e., supply, build and repair tissues.
- The chemical components that perform these functions are called nutrients.
- A food must contain at least one nutrient. Nutritious foods such as milk contain a variety of nutrients and can fulfil all the requirements of the body, while glucose contains only one nutrient.
- Six types of nutrients have been identified in foods. They are carbohydrates, fats, proteins, minerals, vitamin and water.
- Lack of the necessary minimum amount of these nutrients leads to general deficiency and undernourishment while lack of any one particular nutrient in sufficient quantity leads to malnutrition.
- The chemical composition of each group of nutrients and its function in the body are interrelated.
- The nutrients may be classified into three main types based on their biological functions.

  i) The nutrients required for energy include carbohydrates, fats and proteins.

  ii) The nutrients for control of body processes include proteins, minerals, vitamin and water.

  iii) The nutrients required for the growth of tissues and their maintenance include proteins, minerals, and water.
- In addition to the major nutrients, food contains natural or added minor constituents such as colourants, flavours, preservatives, toxins etc.

- The additives in processed foods may be intentional to achieve certain aims during processing such as preservation, emulsification or flavour enhancement or unintentional/ accidental additives such as metallic contaminants and fertilizer and pesticide residues.
- The nutrient contents of a few typical foods are shown below,

FOOD	WATER	CARBOHYDRATES	FATS	PROTEINS	MINERALS AND VITAMINS
Milk	88	4.8	3.8	3.3	0.1
Egg	74	0.9	11	12	0.1
Apples	84	112	0	0.3	0.1
Chocolate	0	53	38	08	0.8
Bread	38	52	2	7	1.0

CARBOHYDRATES:

Definition:

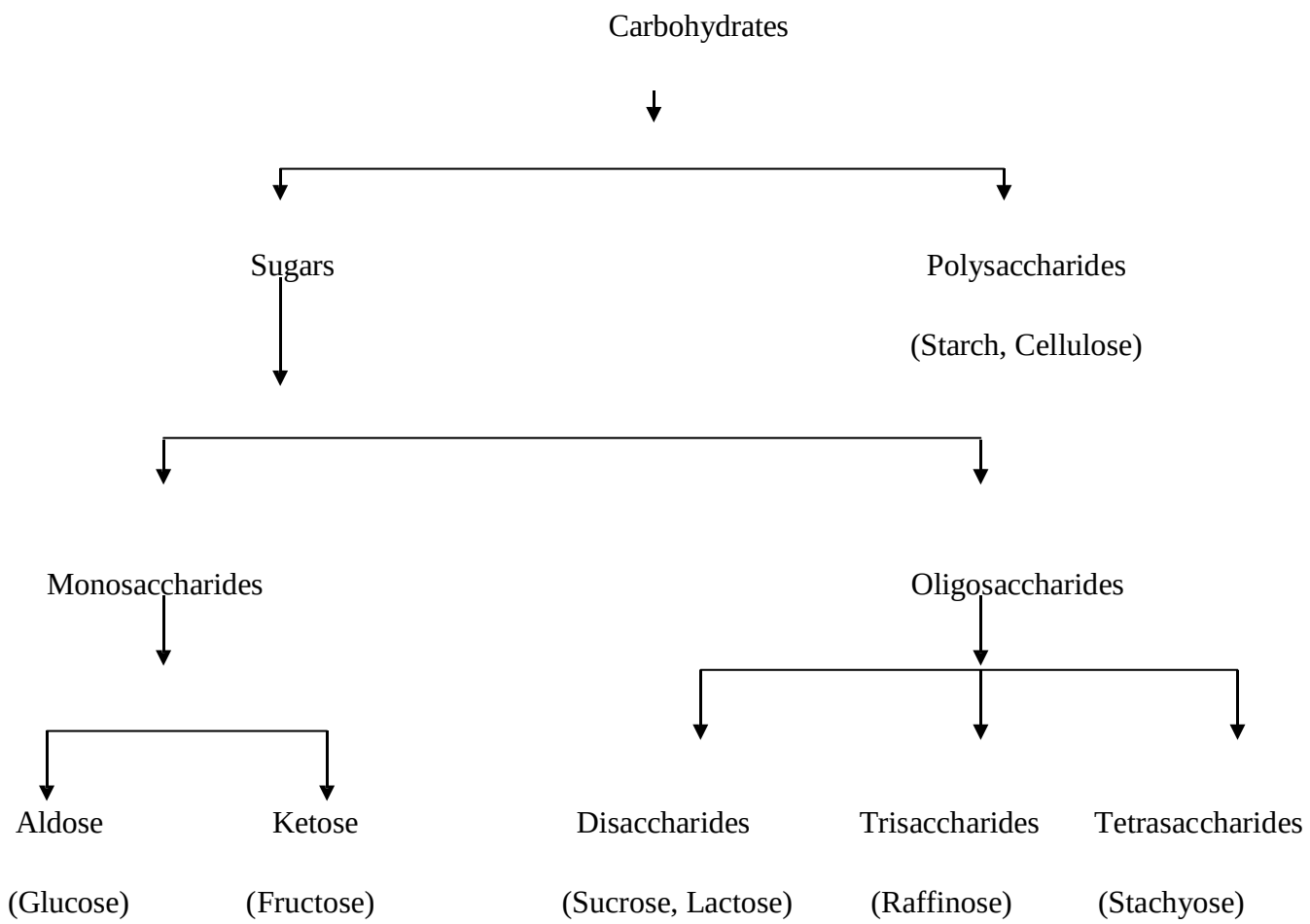
Carbohydrates are defined as the optically active poly hydroxyl aldehydes or ketones or substances which yield such products on hydrolysis.

They are the chief source of energy in our diet. The chemical compounds containing carbon, hydrogen and oxygen. They provide instant energy to our body.

Sources:

- Carbohydrates are widely distributed in nature in plants and animals.
- The most important carbohydrates are found in plants are starch.
- The chief sources of carbohydrates are rice, wheat, maize, barley, potato, sugarcane, beetroot, banana etc.
- The carbohydrates are found in animals are glycogen.
- The storage form of carbohydrates in animals are abundantly in the liver and muscles.
- Sucrose is largely taken in the food is obtained from sugarcane. It also present in the nectar of flowers and in fruits.

Classification:



Carbohydrates are classified into two main groups,

1) Sugars
2) Polysaccharides

1)Sugars:

- They are crystalline substances.
- They have sweet taste.
- They are soluble in water.
- Example: Glucose, Fructose and Sucrose.

a) Monosaccharides:

The Monosaccharides are carbohydrates which cannot be decomposed by hydrolysis to give simpler carbohydrates. For example, glucose and fructose.

$C_6H_{12}O_6 + H_2O \rightarrow$ No Reaction

Glucose or Fructose

b) Oligosaccharides:

The Monosaccharides are carbohydrates which yield a definite number (usually from 2 to 10) of monosaccharide molecule on hydrolysis. They include,

i)Disaccharides

ii)Trisaccharides

i) Disaccharides:

The Disaccharides which yield two monosaccharide molecules on hydrolysis. For example, sucrose and maltose.

$C_{12}H_{22}O_{11} + H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6$

Sucrose Glucose Fructose

$C_{12}H_{22}O_{11} + H_2O \rightarrow 2\ C_6H_{12}O_6$

Maltose Glucose

ii) Trisaccharides:

The Trisaccharides which yield three monosaccharide molecules on hydrolysis. For example, raffinose.

$C_{18}H_{32}O_{16} + 2\ H_2O \rightarrow C_6H_{12}O_6 + C_6H_{12}O_6 + C_6H_{12}O_6$

Raffinose Glucose Fructose Galactose

iii) Tetrasaccharides:

The Tetrasaccharides which yield four monosaccharide molecules on hydrolysis. For example, stachyose.

2) Polysaccharides:

The polysaccharides are high molecular weight carbohydrates which yield many monosaccharide molecules on hydrolysis. For example, starch and cellulose.

$(C_6H_{10}O_5)_n + n\,H_2O \rightarrow n\,C_6H_{12}O_6$

Starch or cellulose Glucose

- In general, Monosaccharides and Oligosaccharides are crystalline solids, soluble in water and sweet to taste. They are collectively known as sugars.
- The Polysaccharides on the other hand are amorphous, insoluble in water and tasteless. They are called as non-sugars.
- Polysaccharides are quantitatively very large group of carbohydrates, 10 or more monosaccharides units are bound according to the same structural principles as in oligosaccharides.

Functions:

1. Energy source:

- Carbohydrates are important energy sources. Body tissues require a constant dietary supply of carbohydrates.
- The amount of carbohydrate in the body of a man weighing 70 kg is about 365g

2. Protective action:

- In liver, carbohydrates are not only oxidized as fuel, but they also detoxify the toxic substances (drugs)
- **Example:** Glucuronic acid.

3. Sparing action of Protein:

- Carbohydrate has a regulating influence on protein metabolism.
- The presence of sufficient amount of carbohydrates for energy need prevents the sparing of protein for this purpose.

4. Maintenance of heart action:

- Heart action is a life-sustaining muscular exercise.
- The glycogen in cardiac muscle is an important emergency source of contractile energy.

5. Maintenance of central nervous system.

- A constant amount of carbohydrates is necessary for the proper functioning of the central nervous system, especially for the brain.
- The brain is maintained by a minute-to-minute supply of glucose through blood.

Importance:

- The chief function of carbohydrates in the body is that of a fuel when carbohydrates are oxidized in the body they liberate CO_2, H_2O and energy. They supply the major portion of energy required by living cells.
- Certain carbohydrates can be used as the starting material for the biological synthesis of compounds such as fatty acids and amino acids, cholesterol etc.
- Certain products of carbohydrate metabolism act as catalyst to promote oxidation of food stuffs.
- Sugars are called simple carbohydrates. They provide instant energy. Sugars are present in milk and fruits like grapes, banana, sugarcane and beetroot.
- Starch is found in potato, rice, wheat, maize etc. Starch is the main carbohydrate in out diet, since it is present in cereals, which form the major part of our diet.

PROTEINS:

Definition:

Proteins are the body-building food. They are essential for the growth and repair of the body tissues. Proteins are made up of amino acids. Proteins are formed by different combinations of twenty amino acids. Each amino acids contains carbon, nitrogen, hydrogen and oxygen. Some proteins contain elements like sulphur, phosphorous and iron as well.

Classification:

i) Classification based on the source:

Proteins can be classified into two groups depending on their source.

a) Animal proteins are obtained from animal products like milk, cheese, egg, fish or meat.

b) Vegetable proteins are obtained from plants like pulses, soyabeans, nuts like cashew nuts, groundnuts, grains like barley etc.

Food sources of proteins:

FOOD	**PROTEIN CONTENT / 100 g**
Dals and pulses	17-28

Nuts and seeds (except coconut)	16-32
Milk	3-4
Egg	13
Fish, meat, poultry	15-26
Cereals	6-13
Vegetables – beans and peas	4-8

ii) Classification based on the functions of protein molecule:

S.NO	CLASS OF PROTEINS	FUNCTIONS	EXAMPLES
1	Enzymic protein	Biological catalyst	Urease, Amylase, Catalase etc.
2	Structural protein	Strengthening or protecting biological structures	Collagen, Keratin, Fibroin etc.
3	Transport or carrier protein	Transport of ions or molecules in the body	Myoglobulin, Hemoglobulin, Ceruloplasmin, Lipoproteins.
4	Nutrient and storage protein	Provide nutrition to rowing embryos and store ions	Casein, ferritin etc.
5	Contractile or motile protein	Function in the contractile system	Actin, Myosin
6	Defense protein	Defend against other organisms	Antibodies, Fibrinogen etc.
7	Regulatory protein	Regulate cellular or	Insulin, G-protein,

		metabolic activities	Growth harmones.
8	Toxic protein	Hydrolyse enzymes	Snake venom
9	Receptor protein	Help to binds harmones and virus	G-protein.

Role of proteins:

Proteins are the source of dietary amino acids and are used for growth and maintenance of living systems. They are costlier sources of energy compared to carbohydrates and fats and hence the human body utilizes proteins mainly for biosynthesis rather than as an energy source, though the energy yield is 5 k.cal / g of protein.

The protein in our diet provide the amino acids from which body synthesizes its own proteins, the major constituents of tissues. The action of hydrolytic enzymes in the stomach as well as the small intestine breaks down food proteins to their component amino acids.

Requirements:

- The recommended daily amount of protein for adults is about 1.8 g per kg of body weight.
- Infants up to the age of one year, the recommended amount is between 2.0 to 2.2 per kg of body weight and between one year and twenty years, 1.0 to 1.8 g per kg of body weight.
- Protein requirement will be higher during pregnancy and lactation and during recovery from illness.

Functions:

- Proteins are the principal nitrogenous constituents of protoplasm of all tissues of plants and animals.
- They are necessary for the synthesis of body tissues and for regulatory functions
- The primary function of proteins in living cell is to promote growth and maintenance of tissues.
- Proteins undergo mechanical digestion in the mouth.
- It is turned into a semi solid and mixed with the saliva
- The metabolic activities of proteins are balance, building tissues (anabolism) and breakdown of tissues (catabolism).
- Proteins are body building food
- Each gram of protein supplies four calories of energy to the body

Importance:

- Proteins build new tissues in growth stages of life, from conception up to adulthood and after injury.

- Maintenance of tissues already built and replacement of regular losses.
- As regulatory substances for internal water and acid- base balance.
- Formation of enzymes, anti-bodies, some harmones and one of the B-vitamins.
- Energy supply.
- Each gram of protein supplies four calories to the body.

Deficiency:

- The deficiency of protein and energy to a varying extent is one of the most common nutritional deficiencies in India.
- Children tend to have retardation of growth and adolescents have thin and lanky bodies, pregnant women gain insufficient weight and have babies, who are low in weight at birth, which may be at risk.

FATS AND OILS:

- Fats and oils represent the most prevalent category of lipids and together with phospholipids are the most important food constituents. Liquid fats are called oils.
- For example, soyabeans oil, olive oil, cotton sead oil, sesame seed (gingely) oil, groundnut oil, mustard oil etc.
- These are mainly of plant origin. Lard (pig fat) and tallow (bovine fat) are examples of non-liquid fats of animal origin and horse oil is a liquid fat.

Classification:

Fats and oils can be classified according to their group characteristics into five fat groups.

i) Milk fat group

ii) Lauric acid group

iii) Oleic-linoleic acid group

iv) Linolenic acid group

v) Animal depot fat group

i) Milk fat group:

It is essentially from the milk of cow, buffalo, goat and sheep. This group is characterised by the presence of oleic acid (30-40%), palmitic acid (25-32%), stearic acid (10-15%) and butyric acid (3-15%).

ii) Lauric acid group:

It contain high percentage of lauric acid (40-50%) which is a C_{12} acid and lesser amounts of $C_{8,}$ $C_{10,}$ $C_{14,}$ C_{16} and C_{18} acids. The unsaturated acid content is extremely low and hence the fat group has a longer shelf life. This fat group has low melting temperature. Commonly used fats of this group are obtained from coconut and palm seeds.

iii) Oleic-linoleic acid group:

It contain only fats and oils of vegetable origin. This group contains less than 20% of saturated fatty acids. For example cotton seed oil, corn oil, sesame seed oil, peanut oil, sunflower oil, olive oil and sawflower seed oil.

iv) Linolenic acid group:

It contain linolenic acid predominantly along with oleic and linoleic acids. For example soyabean oil, wheat germ oil, perilla oil and linseed oil.

v) Animal depot fat group:

It consists of hard and tallow. These contain 30-40% of C_{16} and C_{18} saturated fatty acids and up to 60% of oleic and linoleic acids. The melting points of these fats are relatively high.

Food source of oils and fats:

FOOD	**PER 100 g**	**CALORIES / 100 g**
Vegetable oil	100	900
Vanaspathi	100	900
Ghee	99.5	895
Butter	81	729
Mutton muscle	13.3	194
Eggs	13.3	173

Role of Fats and Oils:

i) Fats and oils are the most concentrated source of food energy. They provide energy at 9 k.cal / g. They perform the function of energy storage in seeds, fruits and in animals.

ii) They function as carriers of fat-soluble vitamins.

iii) They contribute to the flavour and palatability as well as to the feeling of satiety after eating.

iv) Lipids in the form of triglycerides, phospholipids, cholesterol and cholesterol esters are important to the structure and permeability of membranes and cell walls.

v) Lipids are a major component of adipose tissue, which serves as thermal insulation for body as protection against shock to internal organs and as a contributor to body shape.

Functions:

- Fats serve two basic functions in the human body. One is primary metabolic function to produce energy. Second is the structural function to protect vital oxygen.
- Fats and oils make food tastier.
- A major part of the food you eat is used to derive energy for day-to-day activities.
- A small part of the remaining food is converted into fat and stored in the body.
- Fats thus constitute an energy bank in the body which provides energy whenever the need arises.
- Fat is mainly stored under the skin and protects internal body organs from jerks and shocks.
- Fats help in the absorption of vitamins A, D, E and K as these vitamins are soluble in fats.
- They are body regulating food and one gram of fat when burnt gives 9 calories of energy.

Importance:

- A major part of the food you eat is used to derive energy for day-to-day activities. A small part of the remaining food is converted into fat and stored in the body.
- Fats thus constitute an energy bank in the body which provides energy whenever the need arises.
- Fat is mainly stored under the skin and protects internal body organs from jerks and shocks.
- Fats help in the absorption of vitamins A, D, E and K as these vitamins are soluble in fats.
- Fats also make food tastier. This is why people crave for fried food like pakoras and samosas. Fats take a longer time for digestion, hence
- We do not feel hungry for a long time after eating fried food.

COLOURS:

Definition:

Vegetable and fruits contribute a variety of colours to the dietary. Food colouring, or colour additive is any dye, pigment or substance that imparts colour when it is added to food or drink. They come in many forms consisting of liquids, powders, gels and pastes.

Classification:

The main pigments in vegetables and fruits can be classified on the basis of colour as carotenoids (yellow)-orange), chlorophylls (green) and flavanoids, which consist of anthocyanins (red-blue-purple) and anthoxanthins (cream yellow). The following pigments are present in plant foods singly or in combination.

1) Natural colours:

These are obtained from natural sources such as grasses, leafy vegetables, fruit skins, root and seeds of plants. Animals can also be a source of food colourings. Cochinel or carminic acid is red colour that is obtained from the bodies of certain scale insects.

- ✞ Flavanoids found in many flowers, fruits and vegetables.
- ✞ Indigoid found in beet root.
- ✞ Carotenoids found in carrots, tomatoes, oranges and most plants. Carrot contain an orange molecule called beta carotene, which is part of this group.

i) Carotenoids:

Carotenoids are fat-soluble pigments. The yellow orange coloured pigments are present in many vegetables and fruits such as carrots, pumpkin, mango and orange. It was first isolated from carrots and therefore was named carotene.

ii) Chlorophyll:

Chlorophyll, the green pigment of plants gives colour to vegetables and skin of fruits particularly unripe fruits. It is lost naturally from leaves. When green vegetables are heated, either during cooking or when they are balanced prior to freezing or during canning the phytol side of the chlorophyll is lost to give chlorophyllide. However, too high an alkalinity affects the texture and flavour of the food.

iii) Anthocyanins:

Anthocyanins cause pink, red, violet and blue color of flowers, fruits and vegetables. Cyanidin is the most important anthocyanin pigment. Grapes contain Anthocyanin pigments.

2) Synthetic colours:

They do not occur in nature and have been made in a factory. They have been carefully tested to make sure that they are safe. Synthetic colours are usually water soluble and can be used in foods without any further processing.

The main examples of synthetic colours are, azo dye such as amaranth (Colour for black currant jams).

List of permitted Colourants

S.NO	NAME	DESCRIPTION	FOOD
1	Curcumin	Orange yellow colour that is extracted from the roots of the turmeric plant	Curry, fats and oils, processed cheese etc.
2	Riboflavin	Also known as vitamin B_2. It can be obtained by fermenting yeast or synthesized artificially. In foods, it is used as an orange-yellow colour.	Sauces, processed cheese and foods with added vitamins such as bread.
3	Tartrazine	Yellow coloured synthetic azo dye. This colouring sparks controversy as some groups suggest it causes behavioural problems in children.	Is no longer widely used. Now rarely used in curries and some ready-meals.
4	Beta carotene	Orange yellow coloured found in plants such as carrots, tomatoes and oranges.	Soft drinks, margarine, butter, yoghurt.
5	Plain caramel	Dark brown to black colour. The most common colouring 90% of all colouring used in caramel. Obtained by the heating of sugars.	Cola drinks, confectionery, baked foods, ice cream, chocolate, beers, vinegar and whisky.
6	Amaranth	Dark purple synthetic colour, similar to black currants.	Powdered soup, jam, ice cream, instant gravy.

Functions:

- Artificial colours are added from external sources.

- The colourants have no nutritive value, but are used to make the food appear more attractive.
- Synthetic colours (10-50 mg per kg of food) than natural colours.(0.05-10gm per kg of food).
- Nature colours in usage levels of 1-30 mg per kg of food.

FLAVOURS:

Flavor or Flavour is the sensory impression of a food or other substance. This is determined by the senses of taste and smell. Flavorant is defined as a substance that gives another substance flavour, altering the taste to sweet, sour, tangy etc.

Sensory perception:

Sensory evaluation of flavours is mainly based on taste and smell. The sense of taste refers to the ability of taste buds in mouth and tongue to recognize the four basic tastes namely, Sweet, Salty, Sour and Bitter. The components of food responsible for tastes are usually non-volatile and soluble in aqueous media including saliva. The taste buds exist in grooves around little projections on the upper surface of the tongue. The anterior of the tongue is more sensitive to sweet stimuli, the posterior portion to bitterness and the lateral portions to sour and salty tastes.

Classification:

i) Fruity flavours:

- The taste of most fruits are a blend of sweetness due to sugars (mostly mixture of glucose, fructose and sucrose) and the sourness of organic acid (malic and citric acid)
- A typical fruit flavour may have different volatile constituents at a total concentration. These include acids, alcohols, esters, aldehydes and ketones.
- A particular fruit flavour is dependent on one or two fairly character impact substances. For example, iso-pentylacetate is the crucial substance in banana flavour although eugenol contributes to the mellow (smooth), full bodied aroma of ripe banana.

ii) Synthetic flavours:

- n-pentyl acetate gives pears flavour.
- Isopentyl acetate gives banana flavour.
- Ethyl butyrate gives strawberry flavour.
- Octyl acetate gives orange flavour.
- Pentyl valerate gives apple flavour.

Specific flavours:

The various flavour components and specific flavour of foods are given below,

TASTE	**AROMA**
Due to non -volatile compounds	Due to volatile components
Sweetness: Sugars, polyhydroxy alcohols, glycosides, carboxylic acids, amino acids, proteins etc.	**Fruity flavour:** Alcohols, esters, terpenes etc.
Saltiness: Alkali metal halides	**Bready aroma** 2,5-dimethylfuranone pyrrolidine
Bitterness: Alkaloids, terpenes, flavanoids, aminoacids and peptides	**Roasted aroma** Thiophenes, pyrroles, pyrazines and methyl pyrazines.
Other taste sensations: Pungency, astringency burning and	**Buttery aroma** 4 - butyrolactone diacetyl.

i) Sweetness:

Sweetness is detected by taste buds at the tip of the tongue. Sweetness has been attributed to be a special characteristics of sugars. However, sugars are much less sweet than sucrose and some varieties of sugars are not at all sweet. The molecular structure responsible for sweetness of substances has been identified as the saporous unit consisting of proton donor/acceptor system.

ii) Saltiness:

Saltiness is detected on the sides and tip of the tongue. Sodium chloride, particularly the sodium ions has a major role in imparting flavour to foods.

iii) Sourness:

Sourness is always assumed to be a property of acidic solutions. In most fruits and fruit juices, citric and malic acid are responsible for all the acidity and sourness.

For example, Tartaric acid is an essential characteristic of grapes while iso-citric acid is that of black berries. Acetic acid is diluted to vinegar and it is responsible for the sourness of many foods.

iv) Bitterness:

Bitterness is associated with several classes of chemicals and it is detected by taste buds at the back of the tongue. Phenolic substances in the form of flavanoids are importance sources of bitterness in fruit juices. Amino acids and oligopeptides are also tastes bitter.

v) Astringency:

Astringency is a sensation related to bitterness but is registered within the oral cavity as well as on the tongue. It is a desirable characteristic of fruits. It is associated with the high content of polyphenolic compounds which are also involved in the production of colour. In tea and wine the polyphenols are called tannins.

NATURAL TOXICANTS:

Definition:

Toxic minerals and metallic contaminants may naturally be present in some plants and animals used as food and water.

Natural Toxicants:

The various natural toxicants are given below,

- **Thiooxazolidone derivatives:**

  The active goitrogenic principles present in the brassicae family has been identified as 1,5vinyl2-thio oxazolidone. It is present in cabbages, turnips etc.

- **Thiocyanates and isothiocyanates:**

  Certain oil seeds, mustard etc, contain thioglucosides which yield on hydrolysis isothiocyanate. Thiocyanogen is present in some foods or is formed from cyanoglycosides present in some foods. These act as goitrogens.

- **Phenolic glycosides:**

  Phenolic glycosides present in the red skin of groundnut have been shown to posses goitrogenic properties.

- **Mushroom poisoning:**

  Two main types of poisonous mushrooms occur. One group e.g, Aminita muscaria contains an alkaloid muscarin which is highly toxic. Second group e.g, Aminita phalloides contains heptotoxic factors which produce severe necrosis of liver leading to hepatic failure and death.

Naturally occurring toxicants in foods:

Certain plants and animals may contain some natural substances that are poisonous. These chemicals may cause disturbances and even sometimes lead to death.

i) Kesari dhal:

- Kesari dhal contains a neurotoxin called BOAA (beta-oxalyl amino alanine).
- This toxin causes the problem in nervous system and leads to paralysis.
- This dhal is often used to adulterate the tuvar dhal.
- This toxin can be removed by pre-boiling the rains before cooking.

ii) Soya Beans:

- Soya beans contain trypsin inhibitors. These inhibitors prevent the breakdown of protein in stomach. This leads to some indigestion problems.
- Trypsin inhibitor can be destroyed by adequate heat treatment.

iii) Green potatoes:

- Green, sprouting and damaged potatoes contain high amounts of solanine. This solanine is to humans.
- It causes vomiting, abnomial pain and diarrhoea etc.
- People should not consume these kinds of potatoes.

iv) Cereals and groundnuts:

- Groundnuts and cereals which are not stored properly may have the aspergillus flavus. This organism produces a mycotoxin called aflatoxin.
- This toxin acts on the lives and causes the damage.

v) Poisonous mushrooms:

- Mushrooms are edible fungi, but some varieties like amanita muscaria and amanito pinalloids are poisonous Mushrooms.

- These produce a toxin, which affects the liver and causes the damage. The symptoms include nausea, vomiting, head ache, dizziness and confusion.

Some toxic minerals present in food and water:

i) Selenium (Se):

- In America, few parts of the soil contain excessive amounts of selenium salts. Fodder and grains grown in these areas, therefore contain excessive amounts of selenium.
- Animal fed of food grains containing excessive amounts of selenium develop toxic symptoms such as depression of growth, loss of appetite, shedding of hair and nails and cirrhosis of the liver.
- Mild selenium poisoning in human beings has been considered to cause stunting of growth, loss of appetite and gastrointestinal disturbances.

ii) Fluorine (F):

- The consumption of drinking water containing large amounts of fluoride will affects teeth and bones. In dental fluorosis, the enamel of the teeth loses its luster and becomes rough and chalky white patches are distributed irregularly over the surface of the teeth, with a secondary infiltration of yellow or brown staining.
- In skeletal fluorosis, there is sclerosis i.e, increased density of the bone of the spine, pelvis and limbs due to excessive calcification. In addition, the ligaments of the spine become calcified, causing a poker back.

QUESTION BANK

2 MARKS:

1) Define food.

2) What are the types of food?

3) Write the sources of food.

4) What are the constituents of food?

5) Define carbohydrate.

6) What is meant by protein?

7) What is flavour?

8) Define colours.

9) What is meant by natural toxicants?

10) Define fats.

11) Write the deficiency of protein.

12) Write any five toxicants present in food.

13) Write any two examples for flavours.

14) Define natural colourant.

15) Give any two examples for natural colourant.

16) Write the types of food.

17) Define artificial colourant.

5 MARKS:

1) Explain the constituents of food.

2) Define food. Explain the sources of food.

3) Give an account on fats and oils.

4) Write short note on colour.

5) Write a brief account on flavours.

10 MARKS:

1) Briefly explain about carbohydrates.

2) Illustrate about protein.

3) Explain the natural toxicants.

UNIT-II

NUTRITION:

Nutrition is the science that interprets the interaction of nutrients and other substances in food in relation to maintenance, growth, reproduction, health and disease of an organism. It includes food intake, absorption, assimilation, biosynthesis, metabolism and excretion.

NUTRIENTS:

Nutrients are molecules in food that all organisms need to make energy, grow, develop and reproduce. Nutrients are digested and then broken down into basic parts to be used by the organism. There are two main types of nutrients.

- Macronutrients
- Micronutrients.

i) Macronutrients:

Carbohydrates are a type of macronutrient used for quick energy in cells. The basic unit of carbohydrates is a monosaccharide. An example of a monosaccharide is glucose or sugar. Glucose can be by itself, or assembled into long chains to make things like starch, which can be found in potatoes.

For example, Proteins are a macronutrient that the cells in your body use for structure. Protein is very important for building tissues, such as muscle. Muscle is mainly made up of proteins. Think how bodybuilders are always eating plain chicken and protein bars - they're trying to build their muscles by getting lots of protein in their diet.

ii)Micronutrients:

Vitamins are micronutrients that are needed to help cells make energy. Vitamins are usually used in conjunction with enzymes to help cells go through metabolism, where they break down food to get energy. There are six major vitamins, A, B, C, D, E and K. Each vitamin has several uses in the body


Vitamin B tablets

NUTRITIONAL STATUS:

Nutritional status is the state of the body in relation to nutrition.

- Clinical, i.e. apparent signs of poor nutrition.
- Growth and development of the body.
- Composition of the body and biochemical parameters.
- Dietary intake is separate from nutritional.
- Status conditional of body in those respect influence by the diet the nutrients i body and the ability those levels to maintain normal metabolic integrity.

i) Good nutritional status:

Nutritional status is the condition of body resulting from the nutrient content of the food. We eat in relation to our nurtritional needs and from the ability of our body to digest, absorb and those nutrient in order to good nutritional, we need certain fundamental condition.

ii) Poor nutritional status:

Its purpose is to differentiate individuals who are at high nutritional risk or have poor nutritional status. There are certain factors which should alert the primary health care team to the fact that nutritional intake may be reduced and that risk of malnutrition is increased.

Poor nutrition can occur for many reasons from a lack of availability of healthy food, to limited knowledge of nutritional requirements and what foods are healthy or a simple tendency to eat the wrong types of food due to personal preferences.

Signs of poor nutritional status

1. Weight Changes

2. Disease and illness

3. Tiredness and lack of concentration

4. Physical symptoms

10 Signs of Good Nutritional status:

Good nutrition is the key to your child's successful development. Use this helpful guide to recognize the 10 Signs of Good Nutrition in your child.

- **Appropriate Height & Weight:**

Your children's appropriate weight in relation to both age and height is a sign of good nutrition and their healthy growth. For a better assessment of this ratio, consult a paediatrician.

- **Strong Bones:**

Strong bones are evidenced by your child's physique and a paediatrician's review. Strong bones and muscles allow your growing children to be better equipped to participate in physical activities, which in turn contribute to stronger bones and muscles.

- **Healthy Skin:**

Healthy skin is an important sign of good nutrition in children and vitamin A supports the maintenance and repair of your child's skin.

- **Good Vision:**

It is important to have your child's vision routinely evaluated when they visit the paediatrician's office. Take care of your child's vision by incorporating vitamin A into their diet, which supports good vision.

- **Muscle Development:**

Muscle development is an important sign that your child is both well-nourished and is exercising properly. Although genetics play an important role in your child's height, adequate high-quality protein in the diet is essential for optimal growth and development. Proteins are the building blocks of the body that help tissue growth as well.

- **Strong Teeth:**

Healthy and clean teeth are proof that your children's nutritional intake and habitual dental hygiene are good. Your child will eventually lose their milk or 'baby' teeth, which are then replaced by adult teeth. Calcium and vitamin D play important roles in supporting strong, healthy teeth.

- **Shiny Hair:**

Shiny hair is a sign of a well-nourished child. Seafood such as tuna and salmon support shiny hair because they are a good source of omega 3 fatty acids. Foods that contain vitamin E and iron also support shiny hair

- **Healthy Nails:**

Strong and healthy fingernails are a good indication that your child is getting the right amount of nutrients they need. Nails should appear uniform in colour and free of discoloration.

- **Sleeping Well:**

Sleeping well is a sign that your child is receiving good nutrition all through the day. It is essential for their growth and development, because many important physical and mental processes such as the release of growth hormones to stimulate the growth of bones, cartilages and tissues - takes place while they sleep.

- **Being Active & Alert:**

Attentiveness is one sign that your child is getting good nutrition through a

healthy diet of nutrients essential for body and brain development.

HEALTH:

Defined health as a state of complete physical, mental, and social well-being not merely the absence of disease and infirmity. The definition is holistic, and it presents three major interrelated components of health.

Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.

The top 10 things you can to do to get healthy now,

- Take 10 deep breaths filling air from the diaphragm up and exhaling completely, whenever you feel stressed.
- Drink 3 liters of good clean water every day in addition to any other beverage you have.
- Eat something raw from the plant kingdom at every meal and make it the biggest part of the meal: vegetables, fruits, legumes, whole grains should be the bulk of what you eat.
- Go to sleep at the same time and get up at same time 6-or-more days of the week. Get at least 8 hours of sleep daily.
- Take a clinically validated, whole food based supplement.
- Eat processed foods sparingly, less than once a week if possible.
- Make breakfast and lunch your biggest meals, preferably between 10 am and 4 pm when your digestion is strongest. Try to eat these two meals at the same time each day; your digestive organs will get the benefit of expecting to go to work on a schedule. This helps tremendously with proper digestion and absorption of nutrients.
- Get outside and move a little bit each day. Fresh air and deep breathing are far more important than getting a workout.
- Start each day with a Green Drink.
- Think good, healthy thoughts.

MALNUTRITION:

Malnutrition is undesirable kind of nutrition leading to ill health. It results from lack, excess or imbalance of nutrients in the diet. It includes both under and over nutrition. Under nutrition is a state of insufficient supply of essential nutrients.

TYPES OF MALNUTRITION:

i) Undernutrition:

– Protein energy malnutrition

– Micronutrient deficiencies

ii) Overnutrition:

– Overweight and obesity

– Health consequences (diabetes, cardiovascular diseases)

CAUSES OF MALNUTRITION:

- General low intake of food due to its short supply (famine) or excessive dieting (anorexia).
- Various diseases, such as diabetes, cancer and infections.
- Physical and psychological trauma, which increases cellular requirements for some nutrients (e.g. vitamin C).
- In these situations, it is more likely that we do not eat or digest food properly and this has a negative impact on the body's immunity.

QUESTION BANK

2 MARKS:

1) Define nutrition.

2) Define nutritional status.

3) What is meant by mal nutrition?

4) Define health.

5) What are the remedies of mal nutrition?

6) Write the functions of nutrition.

5 MARKS:

1) Explain nutrition and its functions.

2) Write note on nutrition.

3) Explain the guidelines for good health.

10 MARKS:

1) Explain the signs of good and poor nutritional status.

2) Discuss about mal nutrition.

UNIT-III

FOOD POISONING AND ADULTERATION

FOOD POISONING:

Pathogenic microorganisms grow in the food utilizing the nutrients in the food and produce toxins which are determental to the health of the consumer when such food is consumed. Food also serves as a vector or medium for certain pathogens that cause food infections and diseases.

Food poisoning or intoxication also results in food borne illness. Indiestion of contaminated food due to the presence of poisons or toxicants causes food poisoning. Food poisoning may be classified into four types depending on the type of poison contaminating the food.

- Bacterial poisoning
- Fungal poisoning
- Biological poisoning
- Chemical poisoning

i) Bacterial poisoning:

Bacterial food intoxication refers to food borne illness caused by the presence of a bacterial toxin formed in the food. The intoxications include botulism and staphylococcal intoxication.

a) Botulism:

The disease is caused by the indigestion of food containing the neurotoxin produced by Clostridium botulinum. The organism is found in soil. It is a spore forming, gas forming anaerobic organism.

Sources:

- Foods involved in causing botulism include inadequately heat processed canned foods of low acidity such as canned vegetables, fruits, fish and fish products, meat and meat products.
- The growth of the organism in some foods such as meat and proteinaceous low acid vegetables produces an obnoxious odour.
- Acidic foods and foods low in protein content may not show putrefaction or spoilage but may still contain the toxin.

Causes:

- The early symptoms include acute digestive disturbance followed by nausea and vomiting, diarrhoea, fatigue, dizziness and headache.

- Other symptoms include double vision, dryness of mouth and constriction of throat, swollen tongue and difficulty in swallowing and speaking.
- The toxin paralyzes the involuntary muscles and paralysis spreads to heart and respiratory system and death results due to respiratory failure.

Remedies:

- Administration of an antitoxin, particularly before the advent of symptoms, is the only known treatment for the disease.
- All foods, raw as well as canned foods which show indication of spoilage should be rejected.
- Canned foods that exhibit any pressure in the container should also be rejected.

b) Staphylococcal gastroenteritis:

Certain strains of staphylococcus aureus produce an enterotoxin which causes gastroenteritis or inflammation of the lining of the intestine.

Sources:

- Foods involved in causing staphylococcal poisoning include custard and cream-filled bakery goods, ham, poultry, meat and meat products, fish and fish products, milk and milk products, salads, puddings, pies, salad dressings and cream sauces.
- Low acid foods, leftover meat products and dressings kept out of refrigerator and heating foods for extended periods with improper control of temperature facilitate the growth of the organism and production of the toxin.

Causes:

- Ingestion of contaminated food leads to gastroenteritis with symptoms such as salivation, nausea, vomiting, retching, abdominal cramps and diarrhoea.
- Blood and mucus may be found in stools and vomits in severe cases.

Remedies:

- Good sanitation and avoiding infected or spoiled raw foods, would save us from getting infected by the organism.
- Adequate refrigeration and adequate heat treatment can kill the organism and deactivate the toxin and thus prevent food poisoning.
- No treatment is necessary ordinarily, but in extreme cases saline solution may be given.

ii) Fungal poisoning:

Mycotoxins are fungal metabolites, some of which are toxic to many animals and potentially toxic to humans. Fungi include molds, yeasts, mildews, rusts, mushrooms and blights. Some are edible (e.g.mushrooms) while others are used in food processing. Species of the genera Penicillium and Aspergillus are known to produce mycotoxins. Mycotoxicosis is the syndrome resulting from the ingestion of mold contaminated food. Other mycotoxins of importance include aflatoxins, patulin, ochratoxin, luteoskyrin, penicillic acid etc.

a) Aflatoxins:

- Aflatoxin are produced by certain strains of the fungi Aspergillus flavus and Aspergillus parasiticus and other organisms.
- Optical conditions for the production of aflatoxin include water activity of about 0.85 and temperature of 25-40^{0}C.
- Many foods such as dairy products, bakery products, fruit juices, cereals, forage crops, peanuts and peanuts meals, cottonseed meal, cowpeas, sorghum, sweet potatoes etc can support the growth of the molds if contaminated or inoculated.

b) Patulin:

- Patulin produced by several molds such as Penicillium expansum, P.clavifome, P.patulum, A.clavatus, A.terreus etc. was first isolated as an antibiotic as it is effective against many bacterial species.
- At lower concentration, it is toxic to mice and rats resulting in pathological changes in organs, while at higher concentration it is fatally toxic to mice and rats.

c) Ochratoxin:

- Molds such as A.ostianus, A.sclerotiorum, A.melleus, P.cyclopium and P.commune produce ochratoxin which is toxic to some animals.
- Foods such as wheat, rice flour and oats are invoved in supporting the growth of toxin producing organisms.

d) Other Mycotoxins:

- Other less-knwn mycotoxins with potential human intoxication include luteoskyrin, sterigmatocystin, pencillic acid, alimentary toxic aleukia, Roquefortine etc. are mostly fungal metabolites which have been investigated with respect to their toxicity and carcinogenic activities in experimental animals.

iii) Biological poisoning:

- A significant number of foods in their natural state contain toxic substances in small amounts.
- Normally the body is able to deal with regular but small amounts of such type foods.
- Biological food poisoning occurs when such foods of plant or animal origin is consumed in excess.
- Examples of such toxins and their effect on health are shown below,

S.NO	FOOD INVOLVED	TOXIN PRESENT	EFFECT ON HEALTH
1	Alcoholic drinks	Ethanol	Vomiting, hangover, unconsciousness
2	Cabbage	Goitrogens	Interference with iodine absorption
3	Raw beans such as soya	Protease inhibitors	Interference with protein digestion and absorption
4	Bread and cereal products	Phytic acid	Interference with iron and calcium absorption
5	Fish (tuna, mackerel)	A variety of toxins	Digestive problems

iv) Chemical poisoning:

- Food poisoning due to chemicals in the food is usually characterized by appearance of the symptoms within a short time after eating the poisoned food.
- Arsenic, antimony, cadmium, chlorinated hydrocarbons, copper, cyanide, fluoride, lead, zinc and nicotinic acid may enter foods from utensils, processing equipment, pesticide or insecticide spray residues on vegetables and fruits, from improper packaging materials or added accidentally in place of normal additives.

1) ACIDITY:

Sources:

- The ulcer may be the common diseases prevalent in many countries.
- The ulcer may be found in the stomach (gastric ulcer) or in the duodenym (duodenal ulcer) due to high secretion of acid.

Causes:

i) Heredity:

- A careful enquiry of the history of the patient may reveal that some of his close relatives might have suffered from the disease.
- In support of the hereditary factors, it has been established that high percentage of persons belonging to blood group 'O' suffer from ulcer.

ii) Nervous stress:

- Highly emotional and nervous persons who are prone to worry, fear and anxiety are particularly susceptible to the development of ulcer.
- The emotional and nervous factors may lead to hyperacidity of the gastric secretions and hypermotility of the stomach.

iii) Gastric hypersecretion:

- Patients with duodenal ulcers have been found to have increased number of parietal cells (acid secreting cells) in the stomach.
- Persons who secretes habitually larger amount of HCl and pepsin in the stomach may be more prone to develop peptic ulcer than others.

iv) Gastric stimulants:

- Caffeine and alcohol cause increased secretion of HCl in the stomach.
- Hence, persons accustomed to drinking too much of coffee or tea or alcoholic drinks are likely to develop peptic ulcer.

v) Diet:

- Gastric tone is increased with severe hunger contractions and acute pain occurring in the empty stomach.
- The volume and concentrations HCl in the gastric contents in increased induodenal ulcer but not in gastric ulcer.

Remedies:

- Mental and psychological rest.
- Administration of drugs viz, antacids, sedatives and antispasmodies to relieve pain and to neutralize HCl.

- Strict avoidance of smoking and drinking of alcoholic drinks, coffee etc.,
- Feeding the patient with milk and a balanced diet rich in proteins in small amounts at regular intervals.

i) Rest:

Rest in bed for a period of 4 to 6 weeks is essential for the treatment of the disease. Rest will help to avoid emotional upsets and will enable the patient to take the drugs and diet at regular intervals

ii) Drugs:

Transquillizers are helpful in decreasing worry and providing mental relaxation. Antacids like magnesium trisilicate and aluminium hydroxide are effective in neutralizing the acidity. Alkalies like calcium carbonate and sodium bicarbonate should be avoided as they form soluble chlorides in the stomach and these salts will have to be eliminated by the kidney. Administration of certain anti-inflammatory drugs helps in the heating of the ulcers.

iii) Diet:

The diet is the most important factor in the treatment of ulcer.

- **Quantity of food:**

The quantity of food given should be small and gradually increased as the intervals between the feeds are longer.

- **Intervals of feeding:**

Initially, feeding what milk may be given at hourly intervals. This is essential as pain recurs in the empty stomach.

- **Neutralization of acid:**

Foods such as milk and eggs have a high acid buffering capacity. By frequent feeding with milk, neutralization of acid in the gastric content is achieved.

- **Inhibition of acid production:**

Cream, vegetable oils, butter and egg yolk inhibit gastric secretion and reduce motility.

- **Avoidance of fibrous foods:**

Foods rich in fibre such as whole cereals and their products, whole legumes and vegetables rich in fibre should be strictly avoided as these tend to irritate the stomach and increase gastric motility.

- **Avoidance of gastric stimulants:**

Some beverages and food products while stimulate gastric secretion should be avoided. They include caffeine containing beverages (coffee, tea and cola beverages), alcoholic drinks, spices and condiments, meat extractives and meat soup.

2) GASTRITIS:

Sources:

Gastritis is a condition in which the mucous membrane of the stomach are inflamed. Gastritis may result from,

- Toxins of bacterial origin which may reach the stomach through blood in certain diseases (influenza, pneumonia etc.,)
- By allergic reaction due to a specific idiosyncrasy to some food.

The clinical features of gastritis:

- Mild anorexia.
- Vague discomfort to severe loss of appetite.
- Pain.
- Vomiting etc.

Types:

i) Acute gastritis

ii) Chronic atrophic gastritis

Causes:

- Pain
- Nausea
- Vomiting

Remedies:

- Elimination of the casual agent by appropriate therapy, e.g., antibiotics, gastric lavage, antidotes for specific poisons etc.

- The administration of drugs to mitigate stomach pain and nausea.
- Withdrawl of solid food for 24 to 72 hours.
- The replacement of losses of water and electrolytes orally in fluids given are retained parenterally. If vomiting continues, the patient should be given water containing salt (0.5%) and glucose (5%) add fruit juice (20%) about 150 ml every hour.
- When the patient's condition improves, fruit juice and barley water with added milk and glucose may be given in small amounts once in 2 hours.
- After 3 days, porridge, pudding and bread may be included and slowly a balanced diet similar to that recommended for flatulence may be given.

3) INDIGESTION:

Sources:

The term 'Dyspepsia' is used for a condition in which difficulty in digestion of food.

Causes:

- Anorexia
- Nausea
- Epigastric pain
- Discomfort
- Distension of the stomach.

When there is no structural change in any part of the alimentary canal, it is described as 'Functional' dyspepsia. Functional dyspepsia is due to anxiety neurosis which interferes in the normal nervous control of the function of alimentary canal.

In dyspepsia, there is a great variation in the quantity of acid secreted by the stomach, the gastric contents ranging from hypo-acidity to hyper-acidity in different subjects. There may be deficient secretion of various enzymes

Remedies:

- The patient should be put on a balanced low-residue diet not containing any spices and condiments.
- Supplements of diastase preparations can be given after food.
- The subjects should take daily one multi-vitamin tablet providing the daily requirements of all vitamins.

4) CONSTIPATION:

Sources:

Constipation is characterized by either incomplete evacuation of stools daily or delayed evacuation of hard stools once in 2 or 3 days.

Types:

In clinical practice, the term constipation is used to denote four types due to,

- Colonic statis (atonic constipation)
- Rectal statis (dyschezia)
- Irritable colon syndrome (spastic constipation)
- Intestinal obstruction.

1) Colonic statis:

Causes:

Atonic constipation is commonly due to,

- Inadequate intake of roughage in the diet.
- Inadequate water intake.
- Lack of physical exercise.
- Weakness of the voluntary muscles of defecation (the abdominal muscles and the muscles of pelvic floor).

Remedies:

- Correction of faulty habits.
- Prescribing the right type of diet. (carbohydrates, vegetables and fruits, whole cereals, pulses)

2) Rectal statis:

Sources:

This condition differs from atonics constipation in two respects.

- The subject passes hard stools once in 2 or 3 days.
- The subjects do not have an urge to defecate even when the rectum is distended with feces.

Causes:

- Persistent neglect to answer call to defecate in early childhood.
- Lack of roughage in the diet.
- Weakness of the abdominal muscles and muscles of the pelvic floor.
- Inadequate water intake.

Remedies:

- The patient should be advised to practice the habit attending to the call to defecating in the morning.
- All stron laxatives should be forbidden and enemas should be discontinued.
- The subject should take before retiring to bed liquid paraffin and a jelly preparation made from agar or tragacanth.

FOOD ADULTERATION:

Food adulteration is the act of intentionally debasing the quality of food offered for sale either by the admixture or substitution of inferior substances or by the removal of some valuable ingredient

Some common adulterants and the diseases caused by them,

i) Milk: Cow / buffalo milk can be adulterated with starch, milk powder and urea.

Health effect: Cancer or acute renal failure

ii) Tur dal, Turmeric powder, mixed spices, saffron:

Adulterants: Metanil yellow, a non-permitted colour is a common adulterant in food items like laddu, tur dal and turmeric.

Health effect: tumour and cancer.

iii) Sweets:

Adulterants: Metanil yellow.

Health effect: tumor and cancer.

iv) Mustard seeds and vegetable oil:

Adulterants: Argemone seeds and argemone oil

Health effect: Epidemic dropsy

v) Honey:

Adulterants: Jaggery, Sugar, corn syrup

Health effect: Obesity, Diabetes, Eyes and nerve damages

TYPES OF FOOD ADULTERATION:

i) Intentional adulteration

ii) Accidental adulteration

i) INTENTIONAL FOOD ADULTERATION:

Intentional food adulteration is usually done for financial gain. It includes adding something intentionally, with knowledge to earn

Common forms of Intentional food adulteration are,

- Addition of water or Urea to liquid milk.
- Addition of Argemone Seeds to Mustard seeds.
- Addition of washing powder to Ice creams.
- Addition of chalk to Sugar.
- Aluminium Foil to Silver Foil.
- Water to Honey.
- Chicory to Coffee.
- Coloured leaves and Iron fillings to Tea.
- Vanaspathi to pure ghee or Butter.
- Papaya seeds to Black pepper.

  Health problems : Appendicitis and Small Intestine problems.

- Rodamine culture (a biological stain), Brick powder to Red chilli powder.

  Health problems : Loss of Vision and Respiratory diseases

- Metanil Yellow to Turmeric Powder, dal, moong and washed channa.

  Health problems : Anaemia, Epilepsy, neurotoxity.

- White powered stone to Common salt.

  Health problems : Appendicitis

- Argemone oil to Groundnut Oil

  Health problems : Loss of Vision and Heart diseases.

- Melami was added to infant formula and pet food.

  Health problems : Falsify the level of protein content.

ii) ACCIDENTAL FOOD ADULTERATION:

Accidental food adulteration occurs accidentally in nature, without our knowledge.

Common forms of Accidental food adulteration:

When food adulteration occurs accidentally, a variety of green vegetables is grown in marshy areas of Chennai outskirts. These areas have high levels of industrial pollutants, including heavy metals, which are absorbed by the plants. The harvested leaves find their way to the market at a cheap rate.

Health problems:

- A chunk of the green leafy vegetables sold in urbal area is found to contain toxic metals that have the potential to harm various organs of the body.
- It is common in almost all developing countries and its ugly face is come out in the form of its harmful effects as stomach disorder, giddiness and join pain, diarrhea, liver disorder, dropsy, gastrointestinal problems, respiratory diseases, cardiac arrest, glaucoma carcinogenic effects, paralysis etc. in a developing country is at the lowest rung of the development ladder, food adulteration consists of relatively simple measures.

i) Adulteration in Organic foods:

- Organic foods are the products must be grown and manufactured in a manner that adheres to standards set by the country they sold in.
- Organic farms do not consume or release synthetic pesticides into the environment. But, some of which have the potential to harm soil, water and local terrestrial and aquatic wildlife.
- The most common organic pesticides, accepted for restricted use by most organic standards include Bt. pyrethrum and rotenone.

ii) Adulteration during irradiating the foods:

- Food irradiation is the process of exposing food to ionizing radiation to destroy and check the multiplication microorganisms, bacteria, viruses, or insects that might be present in the food.
- Further applications include sprout inhibition, delay of ripening, and improvement of re – hydration. Cobalt-60 is the most commonly used radionuclide for food irradiation.
- For irradiating the foods the quantity of dosage is very much important. They

Food is dectected adulterated if:

- A substance is added which depreciates or injuriously affects it.
- It is cheaper or inferior substances are substituted wholly or in part.
- Any valuable or necessary constituent has been wholly or in part abstracted.
- It is coloured or otherwise treated, to improve its appearance or if it contains any added substance injurious to health.

FOOD ITEM	ADULTERANT	SIMPLE METHOD FOR DETECTING THE ADULTERANT
Sugar Powder	Chalk	Dissolve sugar in a glass of water, chalk, white Sand, Stone powder will settle down
Red Chilli Powder	Brick Powder	Brick powder settles fast chilli powder settles slowly when put in water
Red Chilli Powder	Red Colour dye	Sprinkle some Chilli powder on the surface of water in a glass beaker. Artificial colorants will descend as coloured streaks

QUESTION BANK

2 MARKS:

1)Define food poisoning.

2)What are the sources of food poisoning.

3)Write the remedies of food poisoning.

4)Define acidity.

5)What are the causes of acidity.

6)Define gastritis.

7)What are the sources of indigestion.

8)Define food adulteration.

9)What are the types of food adulteration.

10)Define intentional adulteration.

11)What are the effects of food adulteration.

12)What is incidental adulteration.

5 MARKS:

1)Write note on acidity.

2)Explain about gastritis.

3)Give a brief account on indigestion.

4)Discuss about constipation.

5)Write short note on causes and remedies for gastritis and constipation.

6)Explain the types of food adulteration.

10 MARKS:

1)Briefly explain about food poisoning.

2)Illustrate food adulteration.

UNIT-IV

FOOD SPOILAGE:

The metabolic activity of various microorganisms not only utilizes the nutrients in food but also causes the spoilage of food through undesirable enzymatic changes affecting the quality of the food. The enzymatic changes include the formation of products which contribute off-flavours and affect the organileptic, textural and keeping qualities of the food.

CAUSES OF FOOD SPOILAGE:

Food is mostly subjected to physical, chemical and biological changes and these cause the deterioration in the quality and ultimately the spoilage of food. The major causes of food spoilage include,

- Microorganisms their growth and activity
- Action of native enzymes
- Insects, rodents and parasites
- Chemical reactions of the constituents of food
- Environmental factors such as temperature, moisture, air and light
- Time.

These factors operate simultaneously affecting the quality of food.

i) Activity of microorganisms:

- Microorganism capable of spoiling food are available commonly in soil, water and air on the sins of cattle, fruits and vegetables, on the feathers of poultry, on the hulls of grains, shells of nuts, on the clothing and skin of handling personnel, on processing equipment and within the intestines and body cavities of animal and human body.
- However, they are not found within the healthy living tissues of plants and animals.
- Most raw foods also contain a variety of bacteria, yeasts, molds and contamination increases their numbers and also introduces new kinds. Food spoilage involves association of microorganisms with each other.

ii) Action of native enzymes:

- The activity of the endogenous enzymes in plant and animal foods is often intensified after harvest or slaughter due to lack of control mechanisms in the harvested plant food or slaughtered animal.

- For example, pepsin in a living animal helps in the digestion of protein but does not affect the intestine itself but when the animal is dead, pepsin does contribute to proteolysis of the organs containing it.
- Similarly, uncontrolled ripening of vegetables and fruits results in their spoilage.

iii) Insects, Parasites and Rodents:

- Insects destroy cereal grains, fruits and vegetables by not only consuming the food but by contaminating the food. They also facilitate microbial attack on foods.
- Fumigation of stored plant foods with chemicals such as methyl bromide and ethylene oxide is carried out to control the insects. However, insect eggs persist in the food.
- In the case of cereal flours, the insect eggs are destroyed by throwing the flour with high impact against a hard surface in a centrifuge type machine called entolater.
- Parasites enter the human body mostly through poultry and hogs which have been improperly cooked.
- Rodents apart from consuming considerable quantity of food also contaminate the food through their droppings, urine and filth. Rodents are also carriers of pathogenic bacteria.

iv) Chemical reaction:

- The quality of foods deteriorate due to chemical reactions of the constituents of food.
- The unsaturated fatty acid components undergo oxidation due to exposure to atmospheric air giving rise to oxidative rancidity in fat rich foods.
- Free fatty acids may also be released due to hydrolytic reactions causing odour as well as undesirable changes in the texture of food. Losses of vitamins due to oxidation or light induced reactions also occur.

v) Environmental factors:

- Environmental factors which affect the quality of food include temperature, moisture, air, humidity and light.
- The temperature range over which much of the food is handled is about 10-40^{0}C. Excessive heat denatures proteins, breaks emulsions, destroys vitamins, enhances the rates of chemical as well as enzymatic reactions and dries out food by removing moisture.
- The texture of fruits and vegetables allow to freeze and thaw on the trees is disrupted. Uncontrolled freezing also spoils liquid foods.
- For example, milk tends to curdle and loses protein due to denaturation and the emulsion breaks separating the fat.

- Moisture content in the food and humidity of the surrounding atmosphere also have an important role in the deterioration of the quality of food.

vi) Time:

The quality of food remains at its peak for sometime soon after its harvest or slaughter and thereafter as time progresses, the deterioration in the quality of the food also progresses. There are two simple options for maintaining the food quality, though temporarily.

i) We should keep the food alive as long as possible. For example, keeping fish, poultry etc., alive without slaughtering till required. Similarly, fruits and vegetables may not be plucked till required. This option is however, limited in its application.

ii) The harvested or slaughtered food must be cleaned and cooled immediately. This delays the onset of deterioration of food quality but does not prevent it.

TYPES OF FOOD SPOILAGE:

The various types of foodstuff ranges from cereals, vegetables and fruits, dairy and poultry products, seafood and products made from raw food materials.

i) Vegetables and fruits:

- Market diseases of vegetables and fruits are commonly caused by microbial spoilage.
- Bacterial soft rot of fruits and vegetables is caused by Erwinia, carotovora and pseudomonads such as P.marginalis.
- The organisms break down pectins, giving rise to a soft, mushy consistency, sometimes a bad odour and a water soaked appearance.
- Vegetables such as onion, garlic, beans, carrot, celery, beet lettuce, rhubarb, potato, cabbage, spinach, cauliflower, radish, turnip, tomato, cucumber, pepper and watermelon are affected by the disease.
- Sour rot (or) watery soft rot of vegetables is caused by Geotrichum candidum and other organisms.

ii) Cereals and cereal products:

- The low water activity of wheat, rice, rye, corn and other cereals protects them from microbial attack if stored properly.
- The cereal flours are also relatively protected by the action of bleaching agents used during milling operation.
- Under favourable conditions of water activity, bacteria of the genus Bacillus and molds grow.

- Many of the aerobic sporeformers produce amylase and hence are capable of utilizing starch in flours.

iii) Bakery products:

- The moisture content of commercially made bread is insufficient for the growth of most organisms except molds.
- Rhizopus stolonifer is the common bread mold causing the spoilage known as ropiness in bread particularly in bread stored in high humidity or in bread wrapped while still warm.
- The composition of cakes with high concentration of sugar does not allow bacterial spoilage.
- However, molds cause spoilage of cakes. The baking process is sufficient to destroy many of these organisms but icings, toppings, nuts and fruits added after baking can be source of molds.
- The growth of molds in bread and cakes causes hardening of these items.

iv) Dairy products:

- Milk, cream, butter and cheese are easily caused by microbial spoilage.
- Fresh raw milk and refrigerated raw milk contain many bacteria belonging to the genera of Streptococcus, Leuconostoc etc.
- The growth of Alcaligens viscolactis in raw milk favoured by low temperatures causes ropiness and a slimy layer of bacterial products.

v) Nutmeats:

- The relatively dry products such as peanuts, walnuts, cashew nuts and almonds are safe from spoilage bacteria.
- Molds grow if sufficient moisture is available during storage.

vi) Meat, Poultry and Seafoods:

- Fresh meat is spoiled by microflora coming from the animal's lymph nodes, intestinal tract, hide and from the handling equipment.
- Microbial spoilage of meat occurs due to bacteria from internal sources such as Clostridium perfringens and other enterobacterial species.
- Poultry is mostly spoiled by bacteria of the genus Psedomonas.
- Poultry spoilage occurs mostly on the surface as the inner portions of poultry tissue are generally sterile.
- Fish of both fresh-water and salt-water contain high levels of proteins and nitrogenous constituents with low fat content and practically no carbohydrates.
- Fresh fish and iced fish are spoiled by bacteria while salted and dried fish are spoiled by fungi. Pseudomonas, Acinetobacter and Moraxella species are involved in the bacterial spoilage.

vii) Eggs:

- Egg yolk is an excellent medium for the growth of most micro organisms because of its neutral P^H (6.8) and nutrient content.
- Bacteria grow in the yolk producing H_2S and other foul smelling compounds and also cause the yolk to become runny and discoloured.

vii) Spices:

- Molds and a few bacteria grow on spices if sufficient moisture is available.
- Propylene oxide treatment of spices reduces the bulk of microorganisms, and those that remain do not cause spoilage if moisture level is low.

viii) Mayonnaise and salad dressings:

- The yeast species Saccharomyces and Zygosaccharomyces cause spoilage of mayonnaise and salad dressings by producing gas and destroying the emulsion.

ix) Sugar and confectionery items:

- Sugar gets spoiled only under improper storage conditions such as high humidity. Torula and osmophilic Saccharomyces can cause inversion of sugar.
- Chocolate creams undergo spoilage causing explosion due to the activity of clostridium sp.

x) Alcoholic beverages:

The spoilage of beer and ale is commonly referred to as beer infections caused by bacteria and yeasts. Four different spoilage patterns are common. These are known as ropiness, sarcinase, sickness, sourness and turbidity.

- Ropines is caused by Acetobacter, Lactobacillus, Pediococcus cerevisiae and Gluconobacter oxydans, the beer becoming viscous and oily.
- Sarcinase sickness is caused by P.cerevisiae which produces diacetyl giving rise to a honey like odour to the beer.
- Sourness is caused by Acetobacter sp. And is due to the acetic acid formed by the oxidation of ethanol by the organism.
- Turbidity and off-odours in beer is caused by Zymononas anaerobia and yeasts such as Saccharomyces sp.

FOOD PRESERVATION:

Definition:

It is the process of treating and handling food to stop (or) slow down spoilage.

Principle:

The basic principle behind food preservation is to protect the food form spoilage. The principle is based on,

i) Protection against microbial decomposition by,

- Asepsis (to keep out micro organisms)
- Removal of microorganisms (filtration)
- Stopping the growth and activity of microorganisms (low temperature, drying or chemicals)
- Destruction of microorganisms (heating or radiation).

ii) Protection against self decomposition of food:

- Inactivating or destroying food enzymes (blanching)
- Delaying chemical reactions (antioxidant)

METHODS:

Preservation methods vary according to the food items and quantity of the items to be preserved. There are household and commercial methods of food preservation. The principles of food preservation can be broadly classified into two types. They are,

1) Bactericidal method
2) Bacteriostatic method

1) Bactericidal methods:

In these methods most of the microorganisms are killed. Examples of bactericidal methods of preservations are cooking, canning, pasteurization, sterilization, irradiation etc.

2) Bacteriostatic method:

This method is based on the principle of prevention of multiplication of microorganisms. This may be achieved by removal of water, use of acids, oil (or) spices and by keeping the food stuff in low temperature. The techniques of food preservation can be divided into two groups,

a) Physical method
b) Chemical method

a) Physical method:

Physical methods of preservation such as canning and freezing on killing microorganisms present (or) atleast stopping their growth for long enough, to allow the food to be safely consumed.

Other physical methods include drying, gamma irradiation, exposure to UV (or) high intensity white light, ultra high pressure and filtration.

b) Chemical method:

Chemical preservatives work either as direct microbial poisons or by reducing the pH to a level that prevents the growth of microorganisms. Acetic acid, better known as vinegar has also been used as a food preservative since ancient times. Salted, pickled (or) dried foods were about the only nourishment sailors were offered on long sea voyages before the invention of modern refrigeration and preservation techniques.

PRESERVATION AND PROCESSING BY HEATING:

Definition:

The processing of food by heat is the most important conservation technique of long duration. It aims to kill micro-organisms and inactivate the enzymes present in the food.

By heating methods:

- Preservation of food by the use of heat finds very wide applications compared to other methods.
- Heat may be used either for processing or conversion of foods or simply as a means of preserving the food.
- In heat processing or conversion the application of heat is used primarily to effect chemical changes in food.
- Cooking, frying and baking involve both processing and preservation operations. Cooking makes food palatable and tender and also destroys a large proportion of microorganisms and natural enzymes.
- Cooked foods can be stored for several days provided they are protected recontamination.
- Refrigeration of cooked food is a normal household practice to prolong the storage time. However, cooking will not sterilize a product.
- Cooking also destroys the toxin formed by Clostridium botulinum during a ten minute exposure of the food to moist heat at 100^0C.
- Thus, cooking provides a final measure of protection for the consumer from food borne diseases.
- The killing of microorganisms by heat is due to thermal denaturation of proteins and enzymes of the microorganism required for its metabolic activity and growth.
- The heat treatment necessary to kill the organisms or spores varies with the kind of organism, its state and the environment during heating.
- The type of heat treatment will depend on the kind of organisms to be killed, other preservative methods to be employed and the effect of heat on the food.

- The use of heat also affects the food adversely and hence it is necessary to use only mild heat treatment that ensures freedom from pathogens and enzyme activity and enhance the shelf life of the food.

There are two main kinds of heat processing.

i) Sterilisation:

This is a more severe process which destroys all micro-organisms, and may change the organoleptic qualities of the product.

ii) Pasteurisation:

This is a process by killing most food spoilage organisms and pathogenic (disease causing) organisms.

PRESERVATION AND PROCESSING BY STERILIZATION:

Sterilization:

Definition:

When heat treatment is done above 100^{o}C in order to destroy nearly all micro-organisms present in a food is called sterilization.

Principle:

Sterilization removes infecting microorganisms. It can also remove pathogenic microorganisms or spoiling agents which could devalue the products of fermentation. There are two main methods employed for sterilization:

- Destruction of microorganisms and
- Removal of microorganisms.

This may be accomplished either by chemical or physical methods.

Sterilization method:

The aim is complete destruction of microorganisms. Because of the resistance of certain bacterial spores to heat, a treatment at 121^{0}C of wet heat for 15 minutes or its equivalent is necessary for sterilization. Every particle of the food must receive this heat treatment. If a can of food is to be sterilized, immersing it into a pressure cooker or retort at 121^{0}C for 15 minutes will not be sufficient because of the low rate of heat transfer through the food. Depending upon the size of the can and the type of food, sterilization may require

several hours. During this time, many changes can occur to depreciate the quality of the food. Fortunately, many of the foods need not be sterilized completely.

Most of the canned and bottled products are commercially sterile. It means a degree of sterilization at which all pathogenic and toxin forming organisms as well as all other types of food spoilage organisms have been destroyed. Commercially, sterilized food may still contain a very small number of resistant bacterial spores, but these will not normally multiply in food. However, if they are isolated from the food and given suitable environmental conditions they will multiply. Commercially sterile canned foods have a shelf life of 2 years or more. Even after longer periods, deterioration in the quality of such foods is generally due to texture or flavour changes rather than to growth of microorganisms.

Physical methods:

1. Heat:

Moist heat is readily kills viruses, bacteria and fungi. Exposure to boiling water for 10 minutes is sufficient to destroy vegetative cells and eukaryotic spores.

2. Autoclave:

The surest and most preferred technique for sterilization is the application of steam under pressure at 121°C for 15 minutes or autoclaving. The autoclave consists of a steel chamber capable of withstanding more than 100 ^{0}C.

3. Hot air oven:

- It is the most widely used method of sterilization. Hot air oven utilizes dry heat for sterilization. This type of energy does not easily penetrate materials; therefore long periods of exposure to high temperatures are necessary.
- A holding period of 160°C for 2 hours or 170°C for 1 hour.

4. Filter:

Filtration is an excellent way to reduce the microbial population in solutions of heat sensitive materials

5. Radiation:

It damages or destroys microorganisms. Ultraviolet and ionizing radiation is frequently used in sterilization.

Chemical methods:

A large number of chemical compounds have the ability to inhibit the growth & metabolism of microorganisms or to kill them

- Phenol and phenol compounds.
- Alcohols.
- Halogens (Chlorine, bromine and iodine).
- Heavy metals.
- Dyes.
- Detergents.
- Quaternary ammonium compounds.
- Acids.
- Gaseous agents.

Types:

1. Ultra heat treatment (or) Ultra high temperature (UHT):

- UHT is a continuous process and the product is packaged after sterilisation into sterile containers. Typical temperatures and times specified for UHT treatment of milk are 130ºC – 150ºC for 1-3 seconds.
- As the product is moving continuously when high temperatures can be reached resulting in fewer chemical changes, but having the same sterilising effect.
- UHT treatment was developed to kill (or) inactivate all micro-organisms without causing as much damage to the product as sterilisation. Milk may taste cooked and will be slightly brown in colour.

2. Canning sterilization:

Canning aims to destroy all microorganisms and their spores through the application of heat. This is achieved by sterilising the food within air-tight containers to prevent re-contamination. A variety of foods are canned. These include whole fruits and vegetables, sliced or diced fruits and vegetables, meat and meat products, fish and fish products and soups.

Two general methods of sterilization are commonly used in industry,

a) In-pack sterilization (Sterilization inside containers)

b) Sterilization of the food before placing in the containers.

PRESERVATION AND PROCESSING BY PASTEURISATION:

Pasteurisation:

Definition:

When heat treatment is done below 100^{o}C to kill the pathogenic (disease causing) organisms present in food is called pasteurisation.

Process:

- Pasteurization is a heat treatment that kills part but not all of the microorganisms present and usually involves the application of temperatures below 100°C.
- The heating may be by means of steam, hot water, dry heat, or electric currents and the products are called promptly after the heat treatment.

Objectives:

Two primary objectives are achieved by Pasteurization.

i) The first objective is destruction of majority of but not necessarily all pathogenic and other spoilage microorganisms in liquid foods such as milk and liquid egg. In the case of milk used for cheese making pasteurization destroys all microorganisms that would compete with the desired fermentation process at a later stage. Extending the product shelf life from a microbial and enzymatic point of view.

ii) The second objective is more of relevance in the pasteurization of beer, wine and fruit juice. Pasteurization will also inactive the natural enzymes present in the food. Pasteurized food will contain many living organisms capable of growth thus limiting the storage life of the foods compared to commercially sterile foods. Pasteurized foods may be stored under refrigerated conditions, e.g., pasteurized milk may be stored in a refrigerator for a week or so without developing significant off-flavours.

Preservative methods:

The two main forms of industrial pasteurisation are:

1. **Batch pasteurisation** – Where the product is held in a specific temperature range for a long time, e.g. 62º C – 36º C for 30-35 minutes;
2. **High temperature, short time (or) HTST pasteurisation** – Where the product is heated to a higher temperature but for a shorter time, e.g. 72 º C for 15 seconds for milk, using a plate heater exchange.

Uses:

- When more vigorous heat treatments might harm the quality of the product, as with market milk
- When one aim is to kill pathogens, as with market milk

- When the main spoilage organisms are not very heat resistant such as the yeasts in fruit juices
- When any surviving spoilage organisms will be taken care of by additional preservative methods to be employed as in the chilling of market milk and
- When competing organisms are to be killed, allowing a desired fermentation, usually by added starter organisms, as in cheese making.

For Examples:

- Grape wines may be pasteurized for 1 min at 82 to 85°C in bulk, whereas fruit wines sometimes are heated to 62.8°C or over and bottled hot.
- Beer may be pasteurized at 60°C or above, the time varying with the temperature.
- Dried fruits usually are pasteurized in the package at 65.6 to 85°C for 30 to 90 min, the treatment varying with the kind of fruit and the size of the package.
- In flash-pasteurized, the vinegar is heated so as to be at 65.6°C to 71.1°C when the bottle is closed.

QUESTION BANK

2 MARKS:

1) Define food spoilage.

2) What are the causes of food spoilage.

3) What are the types of food spoilage.

4) Define food preservation.

5) What is meant by sterilization method.

6) What is pasteurization.

7) What are the types of sterilization method.

5 MARKS:

1) Explain food spoilage and its causes.

2) Explain the types of food spoilage.

3) Explain food preservatives by heating method.

10 MARKS:

1) Explain the preservative method by pasteurization.

2) Explain the preservative method by sterilization.

UNIT-V

VITAMINS AND MINERALS

VITAMINS:

Definition:

A vitamin is an organic compound required by an organism as a vital nutrient in limited amounts and must be found in diet. An organic chemical compound (or related set of compounds) is called a vitamin when it cannot be synthesized in sufficient quantities by an organism and must be obtained from the diet.

Types:

Vitamins are classified into two types based on the solubility in water**.**

1) Water-soluble vitamins:

- Water-soluble vitamins do not get stored in the body for long - they soon get expelled through urine.
- Water-soluble vitamins need to be replaced more often than fat-soluble ones.
- Vitamins C and all the B vitamins are water-soluble.

2) Fat-soluble vitamins:

- Fat-soluble vitamins are stored in the fat tissues of our bodies, as well as the liver.
- Fat-soluble vitamins are easier to store than water-soluble ones, and can stay in the body as reserves for days, some of them for months.
- Vitamins A, D, E and K are fat-soluble.
- Fat-soluble vitamins are absorbed through the intestinal tract with the help of fats (lipids).

The Discovery of vitamins and their sources:

Year of discovery	**Vitamin**	**Food source**
1913	Vitamin A (Retinol)	Cod liver oil
1920	Vitamin C (Ascorbic acid)	Citrus, most fresh foods
1929	Vitamin K (Phylloquinone)	Leafy green vegetables
1922	Vitamin E_1 (Tocopherol)	Wheat germ oil, unrefined vegetable oils
1910	Vitamin B_1 (Thiamine)	Rice bran

1920	Vitamin B_2 (Riboflavin)	Meat, eggs
1934	Vitamin B_6 (Pyridoxine)	Meat, dairy products

SOURCES, REQUIREMENTS, DEFICIENCY DISEASES:

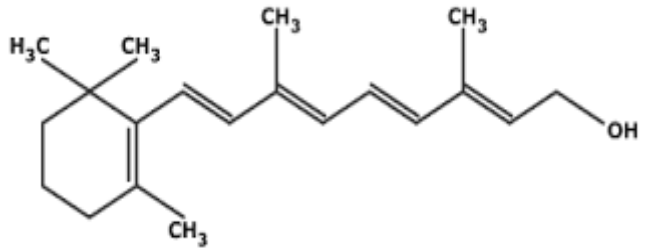
1) VITAMIN-A (Retinol):

Vitamin-A is derived from certain pigments called carotenoids which are widely distributed in nature. They are known as provitamins A. Provitamins A include 4 compounds. They are,

- α- Carotene
- β- Carotene
- γ- Carotene
- Cryptoxanthin

Structure:

- The structure of vitamin-A differs from β- Carotene in that it forms half of the structure of a β-Carotene ring. It has 5 conjugated double bonds.
- Vitamin-A molecule has a terminal primary alcohol group where, β- Carotene does not possess an alcohol group.
- Two forms of vitamin-A occur in nature. They are vitamin-A_1 and vitamin-A_2. Vitamin A_2 has only 40% of biological activity as that of vitamin-A_1, whereas neovitamin-A which is the stereoisomer of vitamin-A_1 has about 70-80% of biological activity of vitamin-A.
- Vitamin-A and the provitamins are insoluble in water and are soluble in most fat solvents.
- Both are destroyed by exposure to light and oxidation. They are however protected from being destroyed by the presence of antioxidants ex, vitamin-E. Though they are not thermolabile, heat accelerates their destruction in the presence of oxygen.
- Vitamin-A content of food is considerably lowered by dehydration, but is not affected by canning or freezing.
- Vitamin-A being an alcohol, forms esters. It can be oxidised to form an aldehyde. Retinene, which is an intermediate in the rhodopsin cyle, is vitamin-A aldehyde.



Sources:

- Vitamin-A occurs mainly in animal sources.
- The main sources are cream, butter, egg yolk, liver, carrot, sweet potato, milk, apple and cabbage etc.
- Carotenoids are found mainly in green vegetables and yellow coloured vegetables like carrots, tomatoes, apricots, sweet potatoes and corn. Cereals contain carotene.

Daily Requirements:

- Adults – 750 micro gram
- Infants and young children - 300 micro gram
- Pregnancy and lactating women - 1200 micro gram.

Deficiency diseases:

- Deficiency may cause night-blindness and keratomalacia (eye disorder that results in a dry cornea).
- It affects the vision, the skin and immune fuctions adversely.

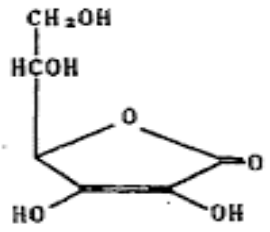
Biological functions:

- Vitamin ‘A’ plays as important role in the development, growth and reproduction.
- It is an important role in the physiological mechanism of vision.
- It regulates and enhances the stability of biological membranes.
- It maintains mucus-secreting cells of epithelia.
- It helps in biosynthesis of glycoproteins.
- It prevents keretinization.
- It is essential for growth. It plays an important role in the construction of normal bone.
- It plays a very active role in vision(eye sight).
- It helps the formation of some epithelial tissues, which are useful in the synthesis of teeth enamel.

2) VITAMIN-C (Ascorbic acid):

Structure:

- Ascorbic acid is an enediol-lactone of an acid with a configuration similar to that of the sugar L-glucose.
- It is a comparatively strong acid, stronger than acetic acid, owing to dissociation of enolic H at C_2 and C_3. D-forms are generally inactive as anti-scorbutic agent.
- Naturally occurring vitamin C is L-ascorbic acid. Strong reducing property depends on the liberation of the H-atoms from the enediol –OHO groups, on C_2 and C_3, the ascorbic acid being oxidised to dehydroascorbic acid.
- It is stable in solid form and in acidic solutions, but it is rapidly destroyed in alkaline solutions.Oxidative destruction of ascorbic acid is accelerated by increasing Ph.
- For ex, by air, H_2O_2, $FeCl_3$, methylene blue, ferric cyanide, 2,6-dichlorophenol indophenols etc.,



L-ascorbic acid

Sources:

- It is widely distributed in plants and animal tissues.
- In animal tissues no storage, contains small amount. But highest concentration in metabolically highly active organs. For ex, adrenal cortex, corpus luteum, liver etc.,
- Dietary sources: Citrous fruits-orange, lemon, lime etc, other fruits like papaya, pineapple, banana, strawberry.
- Vegetables-leafy vegetables like cabbage, cauliflower, germinating seeds, green peas, beans, potatoes, and tomatoes.
- Vitamin C activity is lost during cooking, processing and storage because of its water solubility and its irreversible oxidative degradation to inactive compounds.

Daily Requirements:

- Adults - 75 mg/day
- Infants-30mg/day
- Adolescence- 80mg/day

- Pregnant women-100mg/day
- Lactating women-150mg/day.
- Requirement is increased in presence of infections.

Deficiency diseases:

- Scurvy is characterized by failure in the formation and maintenance of intercellular materials which casue typical symptoms such as, weakness, spongy bleeding, loose teeth.
- Metabolism of tyrosine and cholesterol is partially affected.
- Absorption and utilization of iron and affected.

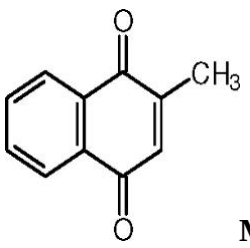
Biological functions:

- It holds the body cells firmly in place.
- Its play an important role to built and maintains strong tissues.
- It's important functions is protein synthesis in human body.
- It helps the body to built resistance to infection.
- It helps in the absorption of calcium and ensures health of bones.
- It helps in the absorption of Iron: it makes available for haemoglobin synthesis.

3) VITAMIN-K:

Structure:

- The vitamins of K group are derivatives of menadione (2-methyl-1,4-naphthoquinone) or menadione itself.
- There are three important forms of vitamin K. These are Vitamin K_1, Vitamin K_2, Vitamin K_3.
- **i) Vitamin K_1: (Phylloquinone)** is 2-methyl-3-phytyl-1,4-naphthoquinone. It was originally isolated from alfalfa leavese .It has a phytyl side chain attached in position 3 of the menadione nucleus. These vitamins are widely distributed in biological systems in small amounts.
- **ii) Vitamin K_2: (Farnoquinone or menaquinone)** is 2-methyl-3-difarnesyl-1,4-naphthoquinone. It has a long difarnesyl chain attached at position 3. It was originally isolated from purified fish meal.
- **iii) Vitamin K_3: (Menadione)** is 2-methyl-1,4-naphthoquinone. This is the simplest and most potent synthetic vitamin K.



Menadione

Sources:

- Food sources are principally derived from plants.
- Green leafy vegetables, alfalfa, cabbage, tomatoes and oat shoots are rich sources of vitamin K.
- Dietary supply of vitamin K_2 is of little importance, because adequate amounts are synthesized by the normal bacterial flora.
- Vitamin K_2 is the product of the metabolism of most bacteria and is present in large amounts in putrid fish.

Daily Requirements:

- Since sufficient quantity of the vitamin is synthesized by bacteria under normal conditions, there is no necessity for dietary requirement of vitamin K.
- However, exogenous supply is necessary only in conditions of potential vitamin K deficiency.

Deficiency diseases:

- The deficiency of vitamin K leads to a lowering prothrombin level and increased clotting time of blood. This may lead to hemorrhagic conditions.
- It causes hemorrhagic disease of the newborn.
- Bleeding tendencies in urinary diseases (or) surgical procedures.
- Vitamin K deficiency is caused by fat malabsorption which may be associated with pancreatic dysfunction, biliary disease, atrophy of the intestinal mucosa (or) any cause of steatorrhea.
- Sterilization of the large intestine by antibiotics can result in deficiency when dietary intake is limited.
- The parental administration of too large doses of vitamin K to infants has been shown to produce hyperbilirubinemia in some cases.

Biological functions:

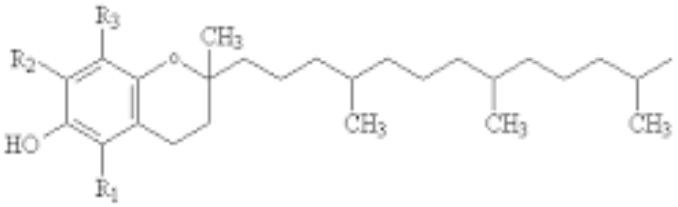
- Vitamin K catalyzes the synthesis of prothrombin by the liver after transcription from information carried on messenger RNA. It reduces the prothrombin time.
- It regulates the synthesis of plasma clotting factors.
- Vitamin K_1 is the essential component of the phosphorylation processes involved in photosynthesis in green plants.
- It initiates blood clotting
- It acts as an essential factor in the oxidative phosphorylation in animal tissues.
- It is involved in the maintenance of normal levels of blood clotting factors of which are synthesized in the liver initially as inactive precursor proteins.

- It is used therapeutically as an antidote to poisoning by dicoumarol type drugs. The quinine forms of vitamin K will bypass the inhibited epoxide reductase and provide a potential source of the active hydroquinone form of vitamin K.
- It is required for the synthesis of other proteins containing γ-carboxyglutamic acid.

4) VITAMIN-E_1 (Tocopherols):

Structure:

- Vitamin E_1 is comprises a number of compounds, which are chemically known as tocopherols. They posses antisterility property.
- The structure of vitamin E contains a tocol nucleus. Four naturally occurring tocopherols have been identified. They are α, β, γ, δ – tocopherols.
- They differ from one another in the number and position of methyl groups on the chroman ring, that is the first ring of the tocol nucleus.
- The tocol nucleus has a saturated hydrocarbon chain common to all tocopherols which are unsaturated alcohols, isolated from the unsaponifiable fraction of wheat germ oil.
- Out of the four tocopherols, α- tocopherol is the more active.



(R_n=CH_3 or H)

Sources:

- Tocopherols occur abundantly in plants.
- All green plants especially lettuce and alfalfa are rich sources of the vitamin.
- Vegetable oils like wheat germ oil and seed germ oils are particularly rich sources.
- Eggs, meats, liver, fish, chicken, oatmeal are also good sources.

Daily Requirements:

- Adult -25 – 30 mg
- Male -12-15 mg
- Female -12-15 mg
- Lactating mothers -15 mg.

Deficiency diseases:

- It causes neurologic disorder.
- Resorption of foetus in female rats.
- Increased oxygen consumption by skeletal muscle.
- Anaemia occurs in pregnant and lactating women and in newborn infants due to the deficiency of vitamin E.
- Anaemia, edema and skin changes are observed in infants when fed unsaturated oils.
- Reproductive failure.
- Shorter life span of red blood cells.
- Liver necrosis.
- Muscular dystrophy.

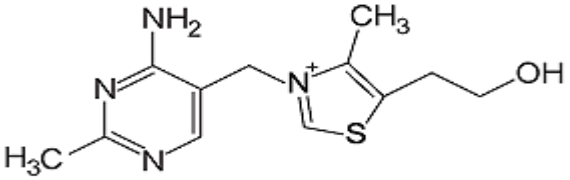
Biological functions:

- It plays an important role in the reproductive activity in animals.
- It is important for the liver integrity.
- It is useful for muscular integrity.
- It maintains the structure and functions of smooth muscle, skeletal muscle, cardiac muscle, vascular tissue etc.
- It protects the red blood cells by inhibiting the oxidase action on haemoglobin.
- It acts as a co-factor in various enzyme systems involved in the respiration and in the biosynthesis of cellular substances like DNA.
- It acts as an electron transferring agent in cells energy metabolism.
- It seems to be involved in heme synthesis.
- It protects enzymes in muscle, nerves or gonads from destruction.
- It prevents the development of cerebral disorder.

5) VITAMIN-B_1 (Thiamine):

Structure:

- Thiamine was the first member of the vitamin B group to be identified and hence given the name vitamin B_1.
- The chemical structure of Thiamine pyrophosphate (TPP) is a cofactor in thiamine was determined by a number of enzymes.
- Thiamine is 2,5- dimethyl-6-aminnopyrimidine bonded through a methylene linkage to 4-methyl-5-hydroxyethyl-thiazole.
- Thus, pyrimidine and thiazole are the two moieties present in its molecule.
- The pyrimidine is unique in that it is the only natural pyrimidine containing as alkyl group.



Sources:

- ✦ It is found in all plants and animal foods.
- ✦ Cereals, heart, liver, meat, milk and kidneys are excellent source of it.

Daily Requirements:

- o Infants - 0.2-0.5 mg daily
- o Men - 1.2-1.4 mg
- o Women – 1mg
- o Pregnant and lactating mother -1.5 mg daily.

Deficiency diseases:

- Vitamin B1 deficiency leads to polyneuretics in animals and beri-beri in human beings.
- Polyneuretics in birds renders them unable to fly, walk or even stand.
- Beri-Beri leads to fatigue, apathy, irritability, depression, drowsiness, anorexia (loss of appetite).
- Gastriontestinal disturbances that can have many manifestations-anorexia, indigestion, constipation, gastric atony, deficient secretion of HC*l* etc.
- Impairment of neutral activity diminished reflex responses.
- Degeneration of mycin sheaths. It may cause nerve irritation.
- Weakening of heart muscles; Palpitation, tachycardia etc

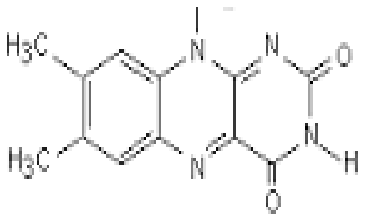
Biological functions:

- ✸ It takes part in the carbohydrate metabolism
- ✸ It is a co-factor for transketolase and it helps to produce active glyceraldehydes.
- ✸ It activates the functioning of some nerve cell membranes
- ✸ It influences the action of neurotransmitters.
- ✸ TTP is necessary for catalyzing the oxidation of carbohydrates in the body. This reaction release energy in the system.
- ✸ Thiamin is needed to maintain the normal functions of three systems in the body, gastrointestinal, nervous and cardiovascular system.

6) VITAMIN-B_2 (Riboflavin):

Structure:

- Vitamin B_2 was first isolated in 1879 from milk when which an essential dietary factor for rats.
- Riboflavin belongs to a class of water-soluble pigments called lycochromes.
- A molecule of thiamine consists of a sugar alcohol, D-ribitol attached to a chromogenic dimethyl isoalloxazine ring at position 9.



Sources:

- In nature, it occurs almost exclusively as a constituent of one of the two flavin coenzyme namely flavin mononucleotide (FMN) and flavin adenine dinuceotide (FAD).
- Milk, cheese, eggs, liver, kidney, heart are the sources of this vitamin.
- Leafy vegetables are good sources.
- Cow's milk contains about 5 times much riboflavin than human milk.

Daily requirements:

- Children and adult - 0.6- 1.7 mg.
- Pregnant and lactation women- 2 mg daily

Deficiency diseases:

- Inflammation of the tongue (or) glossitis.
- Pellagra in human beings and curled toe in chicks.
- Patients suffering from pellagra and beriberi are usually also deficient in riboflavin content.
- The deficiency is usually caused by inadequate intake.
- It show Chelosis (fissuring at the corners of the mouth and lips), glossitis (inflammation of the tongue) and corneal vascularisation (blood shot eyes).

Biological functions:

- It acts as a coenzyme in a series of enzymatic reactions involving the enzymes like xanthine, oxidase, D and L-amino oxidases, aldehyde oxidase, succinic dehyrogenase etc.
- It plays a very important role in the metabolism of carbohydrates, fats and proteins.

- It is essential for growth and tissue respiration it may have a role in light adaptation and is required for conversion of pyridoxine to pyridoxl phosphate.
- When Riboflavin is phosphorylated in the presence of an enzyme flavokinase, it gets converted to FMN which is essential in the biosynthesis of fats.

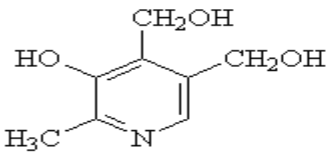
Riboflavin + ATP ↔ FMN + ADP

7) VITAMIN B_6 (Pyridoxine):

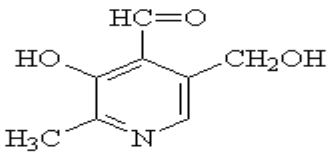
Structure:

- Vitamin B_6 was found to be present in yeast and could be absorbed in charcoal. In 1938, the isolation of vitamin B_6 was derived and also identification of its structure by Harris and Folkers in 1939.

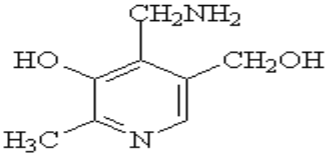
Pyridoxine (Vitamin B6)



Pyridoxal



Pyridoxamine



Sources:

- The major sources are yeast, rice polishing, wheat, corn, liver, kidney, milk, egg, some vegetables, fruits, fish and meat etc.,

Daily requirements:

- Infants – 0.3mg
- Children - 0.6 – 1.2 mg.
- Adult (M) – 1.6 – 2.0 mg
- Adult (F) 1.6 – 2.0
- Pregnant women - 2.5 mg.
- Lactating women - 2.5 mg.

Deficiency diseases:

- A hyper chromic and microcytic anemia.
- Disturbances in the central nervous system.
- Tuberculosis.

- Hyper emesis of pregnancy.
- It may cause anaemia, peripheral neuropathy.

Biological Functions:

- It is a co-factor for several enzyme connected with the metabolism of aminoacids.
- It is also believed to have a role in the formation of antibodies.
- It helps the conversion of the essential fatty acids.

MINERALS:

MINERALS ELEMENT IN FOOD:

Apart from organic nutrients, the body requires inorganic nutrient like water, sodium, Iron, Magnesium, potassium, sulphur and phosphorous that play important roles in metabolic activities. They are builders, activators, regulators, transmitters and controllers. We get many minerals from plants which in turn absorb them from the soil.

PRINCIPAL MINERAL ELEMENTS:

Depending upon the amount, the minerals are classified into three groups. The body contains about 24 minerals, all of which must be provided by the diet.

Group-I: (Major minerals)

These include calcium, magnesium, sodium, potassium, phosphorous, sulphur and chlorine.

Group-II : (Trace minerals)

These include Iron, copper, Iodine, Manganese, Cobalt, Zinc and molybdenum.

Group-III: (Trace minerals-functions, not known)

These include Fluorine, Aluminium, Boron, Selenium, Silicon, Cadmium, Chromium, Vanadium, Tin and Nickel.

These minerals are necessary for the following different functions;

- As constituents of bone and teeth, e.g., calcium, phosphorus and magnesium**.**
- As constituents of body cells of soft tissues such as muscles, liver etc., e.g., phosphorus.
- As soluble salts which give to the body fluids and cell contents, their composition and stability which are both essential for life, e.g., sodium, potassium, chloride and phosphorous.

- Some minerals are required in small quantities for specific functions, e.g., iron and copper – formation of haemoglobin, iodine – formation of thyroxine, zinc – constituent of an enzymes. e.g., carbonic anhydrase and a harmone e.g., insulin and cobalt constituent of a vitamin e.g., vitamin B_{12}.
- Some other elements are essential for the activity of various enzymes.

SOURCES, FUNCTIONS, DEFICIENCY AND DAILY REQUIREMENTS:

1) SODIUM (Na):

Sodium is the chief electrolyte which is found in large concentration in extracellular fluid compartment. The sodium is ofund in the body mainly associated with chloride as NaCl and $NaHCO_3$.

Sources:

The important sources of sodium are,

- Table salt or common salt which sodium chloride. It is used in cooking or seasoning.
- Indigested foods also contain sodium.
- Sodium content is quite high in cheese, claims, bread, wheat, germ and whole grains.
- Sodium is also present in carrots, cauliflower, celery, eggs, legumes milk, nuts, turnips, spinach, radish and prunes.

Functions:

- It helps to regulated acid-base equilibrium.
- It helps to maintain the osmotic pressure of body.
- It helps to preserve irritability of muscles and permeability of cells.

Deficiency:

- Its deficiency results in muscular cramps of the extremities and abdomen, headaches, nausea and diarrhoea.

Daily Requirements:

- Adults =1 – 3.5 gm.
- Infants = 0.1 – 0.5 gm.
- Children = 0.3 - 2.5 gm.

2) POTASSIUM (K):

Potassium is the major intracellular cation. It is widely distributed in the body fluids and tissues.

Sources:

The main sources are meat, poultry, fish, milk and curd, whole – grain cereals and pulses, vegetables and fruits, e.g. bananas, potatoes, tomatoes, carrots, orange, grapes, chiku and custard apple.

Functions:

- It regulates acid-base balance and the osmotic pressure of the intercellular fluid.
- It is needed for certain important metabolic functions e.g., protein biosynthesis by ribosomes.
- Enhancement of relaxation of the heart muscle.
- Some enzymes (e.g., pyruvate kinase) need potassium for their maximal activity.
- It is one of the major cations of intercellular fluid and of extra cellular fluid.
- It influences muscle activity, specially the cardiac muscle.

Deficiency:

- Its deficiency may result in chromic wasting disease with malnutrition, gastrointestinal losses and metabolic alkalosis.

Daily Requirements:

- The daily intake of potassium from the diet and drinking water may range from 2 to 4 gm depending on the composition of the diet.
- All foods are rich sources of potassium and hence potassium deficiency is not likely to occur in normal subjects.

3) MAGNESIUM (Mg):

Magnesium is the fourth most abundant and important cation in humans. It is extremely essential for life and is present as intracellular ion in all living cells and tissues.

Sources:

Magnesium is widely distributed in vegetables, vegetable cells, animal tissues, cereals, beans, green vegetables, potatoes, almonds and dairy products, e.g. cheese.

Functions:

- It is the major cation present in soft tissues.
- It acts as activator of the phosphate group transfer enzymes.
- About 70% of body magnesium is present as apatites in bones, dental enamel and dentin.

Deficiency:

- Its deficiency may lead to neuromuscular dysfunctions as manifested by hyper excitability with muscle tremor and convulsions.

Daily Requirements:

- Adult =200 to 300 mg
- Pregnancy=200 to 150 mg
- Infant= 100 to 150 mg
- Children =150 to 200 mg

4) IRON (Fe):

Iron is one of the most essential trace elements in the body. Total iron content in a human of 70 Kg body weight varies approximately from 2.3 gm to 3.8 gm. Average iron content of adult males is about 3.8 gm and of females about 2.3 gm.

Sources:

- **Animal sources:**

  Meat, fish, liver, spleen, red marrow are very rich sources (2.0 to 6.0 mg/100gm).

- **Vegetable sources:**

  Cereals (2.0 to 8.0 mg/100 gm) are the major rich source. Legumes, molasses, nuts, amaranth leaves and Dates.

Functions:

- Iron is present in haemoglobin, myoglobin, cytochromes and many oxidative enzymes.
- Haemoglobin contains ferrous iron. It is essential for carrying oxygen to different tissues.
- The cytochromes are important enzymes of the respiratory chain. The terminal cytochrome oxidase, catalyses the reaction of hydrogen removed from the substrate with molecular oxygen to form water.
- Metalloflavoproteins are essential for the oxidation of several important metabolites, e.g., succinic acid, reduced nicotinamide, dinucleotide and xanthine etc.,
- Hydroper oxidases is present in all tissues and catalyse the decomposition of hydrogen peroxide formed to water and oxygen.
- Iron helps in the process of cellular respiration.

Deficiency:

- Its deficiency leads to anaemia in pregnancy.
- Reduction in growth.

- Its deficiency causes the bone-narrow to produce small cells (microcytic) with less than optimum haemoglobin content (hypochromic).
- Its severe deficiency may cause a low red cell count.

Daily requirements:

- Infant = 0 – 4 months (adequate in mothers milk)
- 5 – 12 months =10mg
- Child =12mg
- Adult (males) = 3.8gm
- Adult (Females) =2.3 gm.

5) SULPHUR (S):

Sources:

- Sulphur is present in the body in the proteins in the form of sulphur containing amino acids (cysteine and methionine).
- Sulphur is also present in some small amounts in certain other organis compounds, viz., glutathione, thiamine, biotin, coenzyme A, lipoic acid, heparin, taurino, taurocholic acid, sulpholipids, sulphonic acid of cartilages and tendons.

Functions:

- It is the essential constituent of cell proteins.
- Sulphur is involved in the formation of proteins such as keratin, chondroproteins and sulpholipids.
- It forms – S – S – Linkages between two – SH groups of cysteine to form a secondary and tertiary structure of proteins.
- It is important for enzyme activation.
- Formation of active sulphate: Active sulphate participates in several transulfuration reactions.

Deficiency:

- Generally sulphur deficiency is not seen in human beings.
- Food containing methionine and cysteine in adequate quantity would never develop sulphur deficiency.

Daily Requirements:

- The intake of sulphur is mainly in the form of cystine and methionine present in proteins.
- Only very small amounts of sulphur are contributed by other compounds present in the diet.
- The daily sulphur intake will vary with the protein intake.

6) PHOSPHORUS (P):

Sources:

The main sources are vegetables, cereals, pulses, cheese, milk, nuts, meats and eggs.

Functions:

- It is the constituent of bone and teeth.
- It is involved in the carbohydrate metabolism.
- It is the constituent of some enzymes.
- It is essential for the formation of phospholipids.
- Energy transfer: The free energy produced by metabolic reactions may be stored as high energy phosphate ATP, creatine phosphate, acid-base balance.
- The buffer which is effectively handled by kidneys is phosphate buffer. It is a mixture of dibasic and monobasic phosphates.
- It is the constituent of nucleic acids.

Daily requirements:

- About 1.5 gram of phosphate is required to be taken in the diet daily.

Deficiency:

- Its deficiency may result in poor mineralization of bones, teeth etc.
- It may result in richest, osteomalacia and poor growth.

QUESTION BANK

2 MARKS:

1) Define vitamins.

2) What are the sources of vitamin C.

3) Write the deficiency diseases of vitamin B_2.

4) What are the sources of sodium.

5) Define the mineral elements in food.

6) What are the daily requirements of phosphorous.

7) Write the biological functions of vitamin E.

5 MARKS:

1) Write a note on vitamin B_2.

2) Discuss about vitamin A.

3) Describe about sulphur.

4) Write the function, deficiency disease of phosphorous.

5) Explain the sources, functions and daily requirements of iron.

10 MARKS:

1) Explain briefly on vitamin K.

2) Illustrate the following i) vitamin C ii) Potassium iii) Magnesium.

3) Discuss on vitamin C.

REFERENCE BOOKS:

1) Food Chemistry by Seema Yadav.

2) Food Chemistry by Alex V Ramani.

3) Food processing and preservation by B.Sivashankar

4) Nutritional Science by N.Srilakshmi.